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Loading Iron Ore at Duluth Docks

Complete Text of Hoover's Minneapolis Speech

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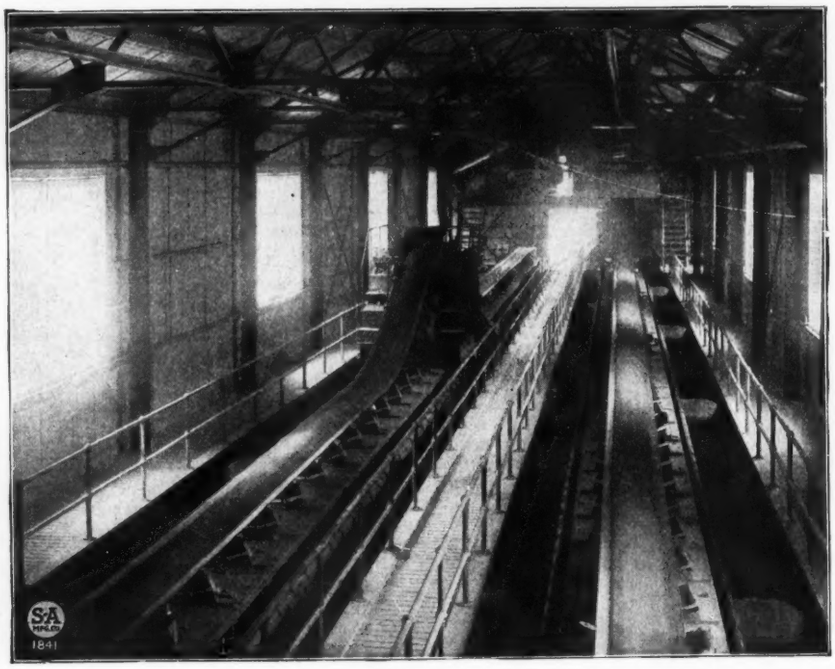

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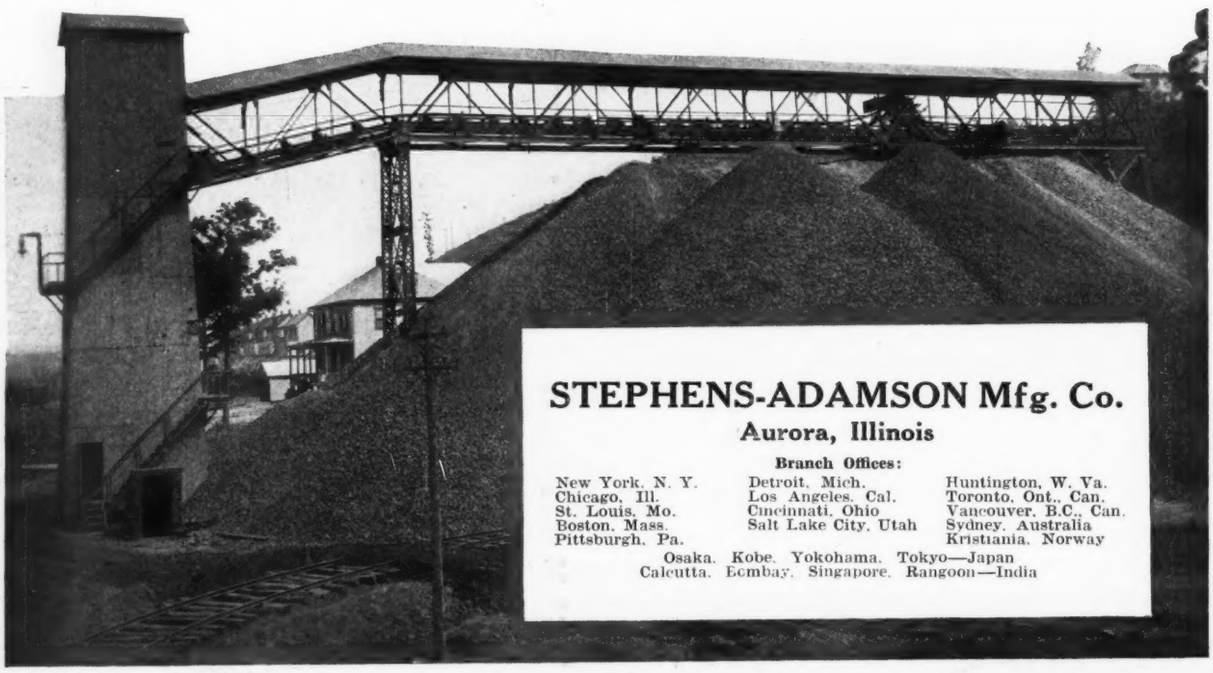

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Engineering and Mining Journal

A Weekly Journal of the Mining and Mineral Industries
METALS NON-METALS PETROLEUM

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The Difference Between Silver And Other Commodities

ONE of the strongest arguments advanced by those who feel that "dollar silver" is inimical to the best interests of the country and the trade in general implies that the action of the Government in purchasing domestic silver at the fixed dollar price—which has now ruled generally above the foreign price—is a policy that might logically be extended to cover other industries, particularly those that had the value of their product, be it wheat, copper, or other commodity, stabilized during the war. It assumes that the same conditions held for silver as for other natural products, and that inasmuch as stabilization during wartime was followed by a repeal of any restrictive price measures in the post-war period for all commodities except silver, the Pittman Act should also be repealed.

It is true that under the present economic system silver is considered a commodity and subject to the same economic laws governing trade in any other mineral or agricultural product, but there are important differences between the precious metals and other commodities which make necessary sharp distinction between their treatment. The demand for silver—gold also—is subservient to the vicissitudes of governmental requirements—both metals discharge important functions and responsibilities in monetary matters, predominating characteristics in their use which cannot be underestimated in considering the moving influences in the silver market. It is not the demand in the arts which is the controlling market factor. Furthermore, quantities of silver and gold, unlike other most ordinary commodities, are being continually added to the world's wealth, and do not deteriorate like the ferrous or nonferrous metals, and are not consumed like wheat or leather, for instance. The precious metals also represent, in small volume and weight, a concentration of relatively great value, a concentration that can be readily accumulated and circulated.

With these essential points in mind the disparity between the precious metals and other commodities indicates why different treatment must be accorded them. Any generalization which sweepingly applies the rules and regulations governing trade in commodities without allowing for any intrinsic differences in certain ones, such as the precious metals, easily leads to the erroneous conclusions mentioned above.

During the last year of the war, the United States, with its large stock of silver, was able to be of very material assistance to the British government and the winning of the war, and under the authority of the Pittman Act unloaded upon the silver market some 207,000,000 oz. of silver, which ultimately found its way to India. In other words, through a governmental agency there was released upon the market about 7 per cent more silver than the entire world's production for that year. Imagine some other agency accumulating stocks of a commodity such as wheat or copper equivalent to the whole world's output and then dumping it upon the market! That is virtually a parallel to what happened in silver. The United States Government stabilized the silver market at $1 per ounce, but only by using a tremendous stock of silver for the purpose.

The necessity of stabilization during wartime is self-apparent, but the benefit accruing from stabilization in periods of peace may not be so clear, although it was shown last year how perilously near the varying price of silver came to upsetting existing currency systems by sending silver coins to the melting pot. It is of lasting good to governments to have a price for silver that is not amenable to speculative manipulation by bullion dealers, whether foreign or domestic. We are inclined to believe that the present silver situation, whereby the entire production of the United States is diverted to the Treasury at a fixed price, is not to the liking of those interests which have always been looked upon as controlling the world's silver market. No longer does the silver producer in this country find that manipulation with the market is playing havoc with his silver. Even foreign silver is exhibiting great reluctance to break more than a few cents away from the dollar quotation, and is strongly feeling the effect of the smaller available world supply.

News From Mexico

TAKEN at its face value, the news received from many parts of Mexico is encouraging and indicates that attempts are being made to revive mining projects, long dormant, but which now, under a seemingly friendlier government, stand a chance of getting a square deal. During the long period of revolutionary unrest taxes accumulated and many claims were jumped. The new government, however, to induce small owners to resume paying taxes, recently issued a decree annulling all previous edicts confiscating property for non-payment, and will permit arrears to be paid in easy instalments. This is not benevolence, it is said, but rather a method of enrolling property owners, for in many sections the official records have been completely destroyed. Those whose claims have been jumped thus have a means of regaining possession of their property.

Statistics of varying nature are issued at intervals from official sources. Indeed, in this respect, the new government, as seen from a distance, appears to be functioning normally. Recently it was announced that 365 companies, working 3,138 mines, are actually operating in the republic today. This, with the information that in many districts the records have been completely destroyed, is to be taken with a grain of salt. Other figures giving the total valuation of the oil, mining, and textile industries in Mexico have recently been issued, but here, too, the data are to be accepted with due reservations.

Some individuals are professedly skeptical of the present government's intentions, saying that it is seeking to secure American recognition by promising everything and giving but little. Such opinions at this time, however, seem most unjust, for in what other way could a new government make its start than this? Assuredly all it can do at the present time is to promise and announce its good intentions. Economic conditions are still too badly upset to permit it to do more.

It would doubtless be hard to find any one person who is sufficiently familiar with all sections of Mexico to judge with complete accuracy of the reliability of news received regarding the widely varying conditions there. The *Engineering and Mining Journal* is seeking to give its readers information obtained from reliable correspondents in this respect, but too much cannot be expected. Indulgence is asked, therefore, until such time as the rehabilitation of rail, telegraph, and postal facilities across the Rio Grande will permit more intimate communication with the southern republic.

Smelting With Enriched Air

ENRICHING the air blown into blast furnaces by the addition of pure oxygen has often been considered, but so far as we know has never been tried on a commercial scale, at least in non-ferrous metallurgical practice. Dr. F. G. Cottrell prepared a short paper on the subject for the New York meeting of the American Iron and Steel Institute last May, though the discussion was confined to the application of the practice to iron blast furnace work.

The reason that the idea has not received wider experimental or commercial application lies, of course, in the cost of the oxygen. Present production in this country amounts to about 3,000,000 cu.ft., or 130 tons of oxygen, per day. About 25 per cent of this is manufactured by the electrical decomposition of water. Theoretically, such oxygen should be produced at about $12 per ton for the electric energy consumed, assuming electric power at 0.2c. per horsepower-hour. The remainder is made by the liquefaction and distillation of air by the Linde and Claude methods, and sells, in large quantities, for 1c. per cu.ft., or about $225 per ton.

The largest single installation for air separation, according to Dr. Cottrell, is at the Government nitrogen plant at Muscle Shoals, Ala., which could produce about 3,000,000 cu.ft. per day, though at what cost we do not know. The use of ozone has also been considered by the International Nickel Co., which collected considerable data on the subject a few years ago, but the cost of production seemed to be too great to offset the indefinite improvement in furnace operation which would be secured by its use.

The use of oxygen-enriched air would result in a more intense heat in the combustion zone of a furnace. Coke could probably be reduced. Its use as an aid to secure pyritic smelting may well be considered. It might prove valuable in connection with the firing of copper and lead blast furnaces with pulverized coal, especially if the ore were refractory. Some of the new volatilization methods might make use of it. Enriched air might also be temporarily used to restore a cold or badly blocked furnace to normal running; in case of blower trouble it might mean the saving of a furnace which would otherwise have to be dug out. The field for experimental work is large, and arrangements could possibly be made with one of the two large producers of oxygen, or manufacturers of ozonizing equipment, for securing the necessary supplies or equipment at cost.

Dressing a Mine for Sale

SALTING is a subject which perforce is continually on the mind of the examining engineer, but which does not receive much mention in the literature of the profession. It may even be held by some that it is dangerous to introduce it into literature, on account of the suggestion which may lead to the practice of fraud, and because of the instruction which it might afford to those who are willing to cheat but are not fully acquainted with the art. However, it is probable that for those who have actually given much thought to the matter as a preliminary for practice, there is little that can be learned. The wiles of trickery are age-old, and they have flourished in the soil of mining venture and mining speculation as everywhere else.

There are all kinds of salting—some questionable, some wholly depraved. What of the very common practice of "dressing" a mine for sale, for example? The recipe is easy: Stop all faces in wide and good ore. The mine makes thereby an unduly good impression on any but the most expert, and in just so far, an incorrect impression is calculatingly produced. Is that reprehensible? It will not fool the wise; but is it not the "children and fools," the half-baked of mining, who should be especially protected, granted that Providence, which otherwise is supposed to take care of this class, apparently abandons them when they pass the portals of a mining tunnel, or step (if so bold) into the bucket to be let down the shaft? On the other hand, the window-dressers would argue, you could not expect them to take out all the visible ore and stop the faces at lean points, when every chance points to other orebodies on further development. They would hold this an unfair and false presentation. They would argue that when a man presents himself to a prospective employer he takes care to shave, put on his best clothes, and make the best impression possible; that the prospective employer assumes this, and would underestimate a man who appears in the guise he often assumes at the end of a particularly hard day's work.

The truth, of course, is midway. The man who courts his prospective wife with vast show of presents, and unduly deferential chivalry, which he does not intend to last forever or perhaps cannot possibly keep up after marriage, is laying the foundation for future disillusionment on the part of the wife, and accusations of having failed to make good. The sample which he displays of his pecuniary and personal resources and attributes must be an average sample, of the kind that will wear. The prospective employee must not by implication or otherwise make impressions or promises which he cannot make absolutely good in the long run. Many choose rather the opposite course, preferring to let deeds speak instead of promises. A mine should not be dressed for sale, but should remain as operation left it; or should be continued working as good judgment suggests, without thought of the impression it may make on a purchaser. A competent purchaser will see and take consideration; and a mine owner should not seek to deceive an incompetent.

The experienced miner who understands the tricks of his mine may use many wiles other than the simple

one noted above. He may progress a step further along the road to iniquity, and suppress bad showings. Winzes may be filled with waste or flooded, because they show the disappearance of ore at the bottom. "Caves" may be allowed to take place by calculated neglect, or helped along, more or less, so as to make inaccessible faults or intrusions which cut off the ore; while the cheerful parts of the mine may be more especially kept open for inspection. Often the unwatering of winzes, or the cleaning out of caves, would take more time than the prospective purchaser has at his disposal, and he must guess at what is not shown and decide with this evidence in doubt.

Sometimes a mine "dresses" itself automatically for sale, and the dishonesty of the owner comes in not explaining to the examining engineer the mine's peculiarities. If the engineer is secretive and given to rebuff, and advises the owner that he knows more than the owner can ever tell him about the mine, and wants to pointers, then indeed the duty of the owner is harder to define.

We remember a case where lead-silver ore replaced limestone, working out from certain almost invisible straight and regular fractures, vertical and intersecting one another at right angles; and the mineralization was confined to a certain limestone bed about ten feet thick. Drifts had been driven along the center of each of the principal fractures, and the natural ore thus stoped out: but the walls were still ore, though of lower grade. The mine was thus developed into blocks by the intersecting drifts, as if all the bed were ore and had been systematically blocked out as a scheme of development; and so the owner dishonestly gave the investigator to understand. Obviously sampling would have indicated a great body of mill ore, on the latter assumption; but with a knowledge of the ore occurrence it would be realized that the assay values would fade away from the walls of the drifts toward a barren center in each block. The fact that ore is blocked out on four sides does not make it safe to calculate it as there, unless one understands the occurrence; but with such expert knowledge, ore exposed on one side only may sometimes more safely be assumed. The only real "ore in sight" is that which is broken down and sampled; and in sampling a mine, the main thing is not the necessary mechanical sampling of faces, with all the usual expert safeguards, but a knowledge of how the ore lies; and in this way the closest approximation to the amount and value of standing ore may be made.

Welfare Work as an Investment

WELFARE work has been defined as the "humanizing of industry." Production, as generally understood, implies the result of industrial application. We have, all told, made tremendous strides in the standardization and improvement of the methods of doing things, with the result, in general, that production has increased; at any rate the necessary program has been outlined for the securing of greater output. Instances where the latter has not kept stride with a rising curve have been due to the failure of some contributing factor: lack of motive power, inability of machines to meet capacity, shortage of raw materials, or the whims of labor and capital.

Increased production usually means lowered costs, and a calculation of the net financial return can usually be made. Money spent in welfare work is productive of no monetary returns; no tangible cash dividends are paid out to the individuals or companies engaging in the work. But the expenditure of money for "humanizing industry" goes on apace, and each year shows greater and greater sums spent for the work. Why? The protection of the workman from accidents, the encouragement of personal and community hygiene, the care of the sick, financial aid to those who are disabled or who have grown old in service, the upbuilding and instruction of a coming generation, Americanization—all these benefits, which are the result of effort in human engineering, are the returns of the investment. Certainly no work that has been done for this object has failed to give bigger and more satisfactory returns.

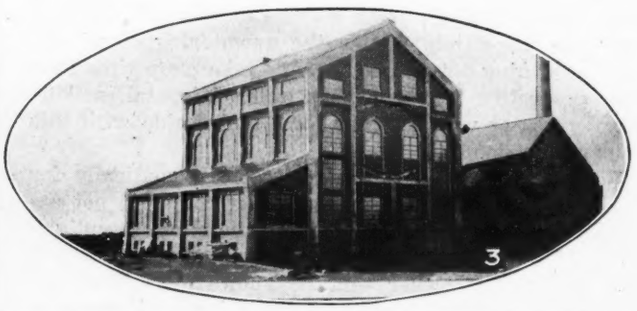
Labor-Saving Equipment

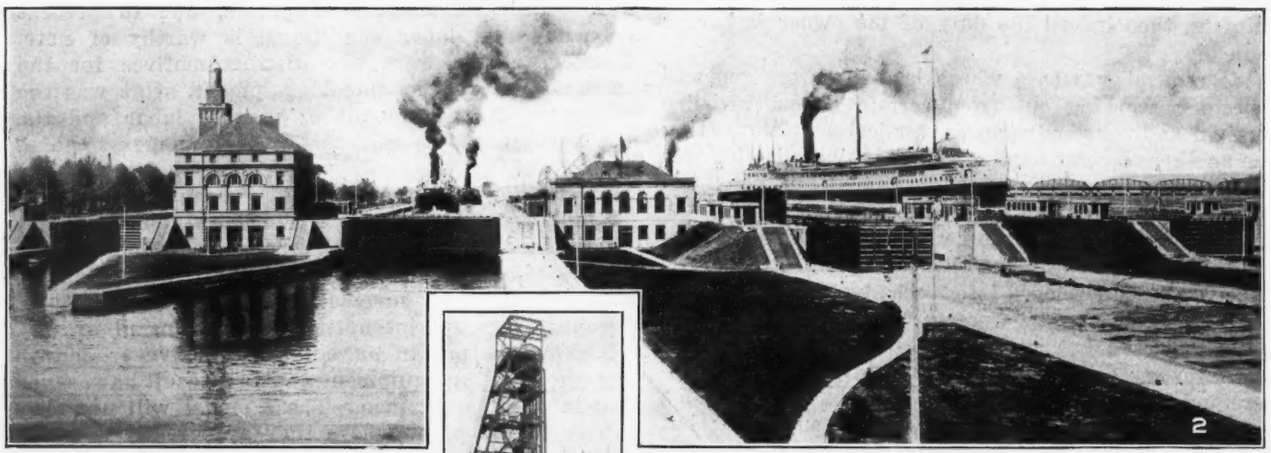
A CHANGE in point of view on the part of the technical managers of plants, due to present economic and labor conditions, is worthy of note. Formerly there were two distinct motives for the introduction of mechanical equipment. One was the reduction in the amount of manual labor and the other decrease in unit cost. As tonnages handled increased, the practicability of introducing mechanical handling of material, with consequent lowering of unit costs, became more and more apparent.

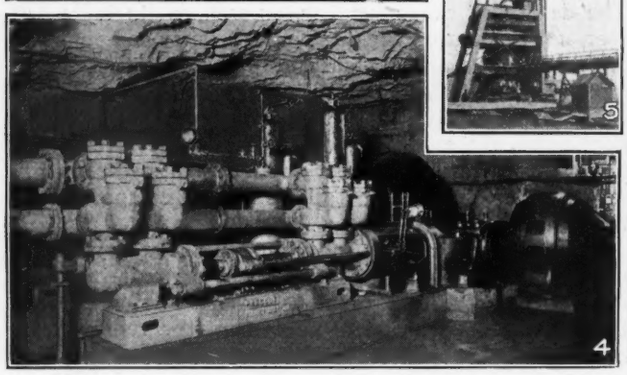
The last fifteen years represents a notable epoch in the mining industry in that there was extensive mechanization of surface and underground plants. Recently the superintendent of a smelting plant said, "I have just put in an additional conveyor belt in my ore-handling equipment and as a result have saved the labor of eight men. These men I will use elsewhere in the plant where they are greatly needed." The dearth of common labor, as well as its increased cost, not to mention the lessened efficiency so apparent, has caused superintendents of plants to study more minutely the detail of handling ore and ore products with the objective of conserving labor. Numerous appliances are available, but owing to the already intensive application of labor-saving devices the opportunities for further installations are comparatively restricted.

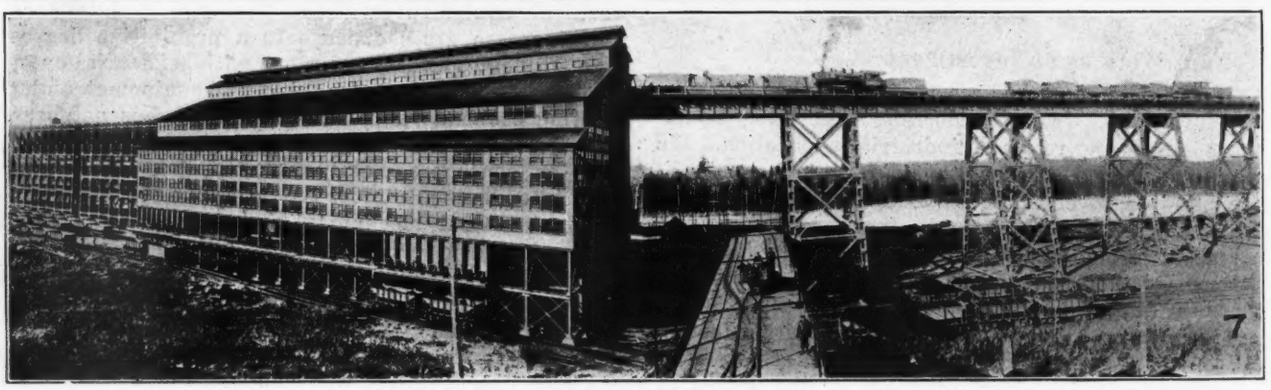
The problem in each individual plant will warrant close study, with a view to improving existing conditions and adding extensions. With an increase in the amount of mechanical equipment the repair force of a plant becomes of additional importance. Mechanical equipment without thorough maintenance may increase gross expense to a prohibitive degree through delays and interference with sequential operations. Maintenance of mechanical equipment under existing economic and labor difficulties has not been easy. There is a scarcity of good mechanics, and here as elsewhere efficiency has fallen off. Plant superintendents are under the necessity of thoroughly developing their mechanical maintenance force, and mechanical engineers can contribute their share by simplifying mechanical devices and substituting better materials for their construction. There is a wide field here for machinery that will stand up to the work with a minimum of maintenance. Manufacturers who can meet this condition will co-operate in a broad way with the industry and assist mining companies in maintaining proper margins between income and outgo.

Some Points of Interest on the



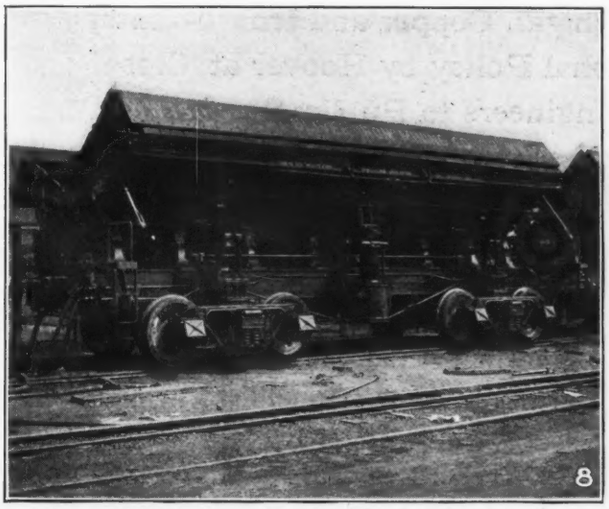


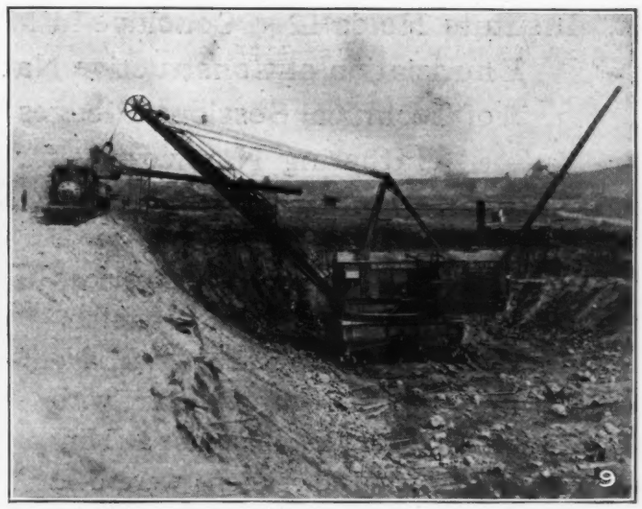




1. Unloading iron ore for Eastern furnaces, Ashtabula, Ohio. 2. Canal and locks at Sault Ste. Marie, Mich. 3. Hoist house, No. 2 Shaft, Quincy Mining Co., Hancock, Mich. 4. Underground pumps at Athens mine of Cleveland-Cliffs Iron Co., Negaunee, Mich. 5. Concrete and steel headframe at Curry mine, Vulcan, Mich. 6. School of Mines Building. University of Minnesota,

Lake Superior Trip of the Institute





Minneapolis. 7. Concentrating plant of Oliver Iron Mining Co., Coleraine, Minn. 8. Twenty-yard, air-operated dump cars used on stripping, Mesabi Range. 9. 350-ton revolving steam shovel, Mesabi Range. 10. Street in Morgan Park, Duluth, Minn., built by the Minnesota Steel Co. for employees. 11. The Minnesota Steel Co.'s plant; Morgan Park, near Duluth, at left.

THE Lake trip from Buffalo to Houghton included part of the route taken by iron-ore and other carriers in their journey from and to the iron- and copper-shipping points of the Lake Superior districts. At Sault Ste. Marie the "Tionesta" passed through the famous locks. A partial conception of the commerce through these canals may be gathered from recent statistics prepared by the Bureau of Foreign and Domestic Commerce which state that during June, 1920, a total tonnage of 10,647,819 was registered. Of this 3,063 tons was copper and 8,725,046 tons iron ore. An excellent example of reinforced-concrete construction is shown at the No. 2 shaft hoist house of the Quincy Mining Co., Hancock, Mich. The walls of this building are of brick veneer and the roof is covered with green tile. Among notable pump installations in the Lake Superior district is that at the Athens mine. In illustration 4 one of the 500-gal. pumps is shown. At the Curry mine, in the Menominee district, a reinforced-concrete structure has been built into and around the steel headframe for the purpose of supporting a gyratory crusher and bin installation. At Minneapolis several of the technical sessions were held at the Mining Building of the University of Minnesota. The Trout Lake concentrator of the Oliver Iron Mining Co. at Coleraine, Minn., has a maximum capacity of 900 tons of crude ore per hour. Mesabi Range stripping equipment has rapidly increased in capacity. In the early operations, cars of 1-cu.yd. capacity were used, whereas modern practice specifies the 20-cu.yd. cars, as shown. This is also true of steam shovels. A 70-ton shovel with a 2-cu.yd. bucket is now replaced by a 350-ton shovel with a 7-cu.ft. bucket.

Lake Superior Meeting A. I. M. E.

Institute Holds 122d Conclave in Michigan Copper and Iron Country—Enunciation of Constructive National Policy by Hoover at Close of Technical Sessions Pledges Engineers to Public Service—Gathering Noteworthy for Display of Patriotic Spirit and Hospitality of Local Industries and Officials

THE 122d meeting of the American Institute of Mining and Metallurgical Engineers was held in the Lake Superior region on Aug. 23 to 28, with the principal stop and banquet at Minneapolis. Technical sessions were held in Minneapolis and Houghton, Mich., and in Hibbing., Minn.

A large party of members of the Institute sailed from Buffalo on Friday, Aug. 20, on the steamship "Tionesta," and were met at Houghton, Mich., by another large group, including the president, Herbert Hoover. At Houghton, the center of Lake Superior mining, elaborate hospitality was provided in the form of facilities for investigation of mines, mills, and smelters. The party then split into two sections, which went each by special train to the Marquette and Menominee iron ranges in Michigan; and each of these trips was replete with interesting technical exhibits and with courteous consideration. The united parties then proceeded to Minneapolis, where technical sessions were held, together with an official lunch in St. Paul and a banquet at Minneapolis. Hoover's speech was the feature of the banquet. The party then proceeded to the Mesabi Range in its special train, where the wonders of the world's greatest iron-mining region were displayed. Returning to Duluth, the engineers of that port arranged a program; and the trip ended at that city.

THE successful meeting of the Institute demonstrates anew the advantages of mixing. For such a summer excursion, the benefits may be summarized as follows, according to importance:

1. The contact and conversation with other engineers, with different themes of specialization, and different geographic experience.

2. The inspiration of mining districts and the study of mining details with which we are not familiar.

3. The reading and discussion of technical papers.

In the winter meetings, the third division, of course, moves up into second place, with the corresponding importance.

It is a condition of further human growth and evolution, collectively and individually, that we shall keep in constant contact with individuals representing other sectors of the component whole, which alone is competent for rounded action; and that out of that contact mutual understanding and concerted action shall arise. In the mining industry we shall more and more need this broader understanding.

The Boat Trip

LEWIS CARROL once wrote something about "T'was brillig——" we forget just how it goes—but in that short bit of nonsense we somehow or other gathered the fact that it was hot; that there was heat of an oppressive and depressive sort. And it was with a similar feeling that the New York contingent of the A. I. M. E. left the Grand Central terminal the evening of Aug. 19. The sweltering heat of the last ten days had done much to upset the normally affable disposition of the mining engineer, so that it was not to be expected that he would "warm up"—that is, in the broad sense. Bnt despite the heat there was some show of enthusiasm, and toward bedtime it began to be evident that the "heat-treated" shell showed signs of breaking.

At Buffalo, amid new surroundings and well fortified with a good breakfast, we were met by other engineers from various points, and made our way to the wharf of the Great Lakes Transit Corporation, where the "Tionesta" was docked. After the usual formalities had been completed, the boat got under way and the first lap of the Lake Superior trip began.

About 150 members and guests made the trip. Those on board included:

Miss Anna W. Jewett,
Miss Louise R. Jewett,
Mrs. John S. Watson,
Mr. and Mrs. Harrison Souder,
Mr. and Mrs. Frank C. Hooper,
Mr. and Mrs. Eli T. Conner,
Mr. and Mrs. J. R. Underwood,
Robert Linton,
Charlton Reynders,
A. J. Strane,
Mr. and Mrs. H. N. Spicer,
Mr. and Mrs. F. L. Estep,
V. E. Edwards,
D. Oliver Brooke,
Mr. and Mrs. P. E. Barbour,
C. P. Perin,
T. W. Tuhyiler,
A. R. Bench,
Walter M. Sanders,
G. F. Woodsmith,
J. Stephenson,
Arthur Thacher,
J. W. Richards,
Mr. and Mrs. J. C. Dick,
G. H. Clevenger,
Alfred W. G. Wilson,
Mr. and Mrs. R. C. Greenfield,
W. R. Hibbard,
Mr. and Mrs. R. V. Norris,
John Stephenson, Jr.,
Geo. L. Collord,
Wm. C. Snyder, Jr.,
Mr. and Mrs. G. H. R. Harris,
J. T. Morrow,
Geo. A. Guess,
H. E. T. Haultain,
H. A. Coy,
R. Dawson Hall,
John T. Breunich,
Arthur L. Walker,
A. M. Cummings,
Earl C. Henry,
Stuart Hazlewood,
J. W. Knowlton,
E. P. McCrorken,
R. H. Richards,
Mr. and Mrs. A. C. Parsons,
S. LeFevre,
H. Kamura,
Philip N. Moore,
J. F. Callbreath,
Mr. and Mrs. J. S. Cunningham,
Mr. and Mrs. W. W. Miller,
Col. and Mrs. A. S. Dwight,
Mr. and Mrs. F. W. O'Neil
Prof. H. H. Stoek and Miss Stoek,
Mr. and Mrs. F. G. Jewett,
John R. Freeman, Jr.,
E. E. Thum,
Bradley Stoughton,
R. C. Allen,
Mr. and Mrs. C. C. Burger,
Mr. and Mrs. C. K. Baldwin,
Mr. and Mrs. Geo. D. Barren,
Richard G. Wood,
J. E. Spurr,
D. E. A. Charlton.

According to a custom which is excellent, the members wore badges in which their last names were prominently displayed, as Hall, Dudley, Siebenthal, and Croasdale. A few, however, apparently elected to use their first names, evidently assuming that they were sufficiently well known. Among these were noted Dick, Arthur, James, Henry, and Ruth.

To those engineers who have not been so fortunate as to include in their list of travels a trip on the Great Lakes we offer condolence, for it will always be with pleasure that we recall that brief journey on the great inland sea. The big blue expanse stretching out in every direction, the splashing of the waves against the ship, the steady throb of the engines—but why continue, for we grow poetical, and, indeed, all we intend to do is to emphasize the delightful calm and the pleasure which accompanied those hours of relaxation. Be it said of Lake Erie that not once did that great body of water express its disapproval of American engineers.

Cleveland was passed during the late hours, so that there was little opportunity for impressions of that thriving Lake city, known the world over as one of the greatest iron-ore receiving ports. At Detroit, the engineers were more fortunate, for promptly at 7 (standard time, although the inhabitants set their Ingersolls one hour ahead, thereby taking advantage of the extra light and good Michigan air) the boat docked, and various parties took advantage of the busses to get a glimpse of the fourth city of our United States. In this connection—we are speaking now of Detroit—it is a matter of regret that Mr. Ford did not avail himself of the opportunity to join the engineers on a visit to the iron ranges, where he has recently acquired extensive interests.

Making Heavy Weather

Leaving Detroit about noon we wound our way through the St. Clair Flats, generally known as the Venice of America, where, according to Ed Wynn, the comedian, any good swimmer can get a job as a traffic cop. Lake Huron, not so well disposed as her southern neighbor, Lake Erie, saw fit to offer a little variation to our previous placid existence. It may be well to pass briefly over this period. There were a few vacant chairs at dinner, some scattering absentees at breakfast, but by noon, as we approached Mackinac Island, all hands were on deck. The storm lasted most of the night, resulted in a delay of four hours, and gave ample evidence of the fact that the landlubber isn't the only one who has his ups and downs.

Mackinac Island boasts of two things: its history and the fact that there are no automobiles on the place. The first is pardonable, because every place must have its beginning. The second is inconceivable, and we are at a loss to understand why Henry Ford and the rest of Michigan's automobile autocracy exert such a slight influence in state politics and permit the passage of laws that allot this domain to the exclusive use of the horse and open victoria.

Owing to the lateness of the hour it was impossible for the visitors to obtain a good view of the Soo locks, which we passed through at 11. In the bright moonlight, however, there was opportunity to view the huge concrete trough into which we slid; the lock-gates closed behind us, the water rose, bringing us up to the level of the water in the channel above, and slowly we moved out into the great expanse of the mighty Superior. Forgotten then, and for some time before, was the heat and sultriness of the city, for the invigorating air raced the pulse, and those who had not already sought their berths were well aware that to stand still was to shiver.

Ocha Potter, who came aboard at the Soo, stated that the copper country delegation whom he represented had ordered a special brand of weather for our benefit. This, be it said, was in absolute harmony with the usual class of entertainment that those good people offer. To one who is familiar with the vagaries of temperature, wind, storm, sleet, and snow that abound in the North Country, it is a remarkable fact that our hosts proved to be such good prophets, for certainly a better stage could not have been set for our reception.

At the present writing—1:30 p.m..—(It is remarkable how this air gets one's appetite, the latter being a very good reason why we will "continue in our next"), we are entering Keweenaw Bay, soon to wind our way through Portage Lake and dock at Houghton.

The Copper Country Meeting

COPPER COUNTRY people do not stint themselves when preparing for or entertaining visitors, and the last gathering of the A. I. M. E. was no exception. Those aboard the "Tionesta" were given a rousing welcome, the whistles of the various plants bursting into sound at the first sign of the boat and continuing until the docking was complete. And this reception was only a beginning, for the streets were decorated with bunting; students of the Michigan College of Mines attended to the transfer of baggage; automobiles were on hand to convey the visitors to Institute headquarters at the Houghton Club or other points—in fact no detail was overlooked to make the stay of the engineers a most pleasant and long-remembered one. The arrangements were in charge of the copper country section of the Alumni Association of the Michigan College of Mines, under the chairmanship of John Knox and the assistance of prominent citizens of Houghton, Hancock, and Calumet.

Registration of delegates began Monday morning at the Houghton Club headquarters. Herbert Hoover, president of the A. I. M. E., arrived by train early in the day and others on the noon train. Owing to the late arrival of the "Tionesta," it was impossible to carry out the complete plans for the day, although those arriving by train were able to visit the Quincy stamp mills, Calumet & Hecla smelter, electrolytic refinery, stamp mills and reclamation plant. After dinner, which was served to members and their guests on dining cars attached to the special train, the visitors were taken to the Onigaming Yacht Club, where an informal dance was held.

Tuesday's program included nine technical visits taken by automobile from the Houghton Club, according to individual preference. These consisted of a geological expedition through the country, trips to the Champion mine, at Painesdale, the Calumet & Hecla mine, the Mohawk mine, the Michigan and Quincy smelters, the Quincy and Calumet & Hecla surface plants, the Calumet & Hecla smelter and electrolytic refinery, the Calumet & Hecla mills and reclamation plant and a general tour of the copper country. This last was arranged for all ladies, members, and guests who were not particularly interested in the mining or metallurgy of the district.

Visit to Ahmeek Mine

The geological trip included a visit to the Ahmeek mine. This was well attended and was chaperoned by the several distinguished geologists that are at present identified with the copper country, including Messrs. Seaman, Graton, Butler, Palache, and Locke. The chief interest was in the steeply dipping cross-fissures of the sixteenth level of this Calumet & Hecla subsidiary. One of the fissures is characterized by native copper, and another by arsenides of copper, and both cut across the main bedded lode without being displaced, and with only slight displacement of the bedded lode by the cross-fissures. A similar cross-fissure vein was inspected at the old Phoenix mine. The early miners first discovered these fissure veins and mined the native copper (mass copper) from them before the discovery of the bedded lodes.

At the Champion mine the visitors were taken to the tenth level, where the methods of drifting and ore removal were explained. The lode at this mine is removed for the entire width, overhand stoping is practised, and the waste rock used in dry walling. A system of selective stoping is used, and by this method it is possible to secure a high grade of copper rock. Where the amygdaloidal rock is rich in copper and there is a little barren rock remaining for dry walling it has been the practice to use stamp sand for filling the stopes above the drifts. The stamp sand is brought into the stopes under pressure through 4-in. pipes. The chutes from main levels through which the copper rock (the copper country miner does not use the term "ore") is dropped are dry walled and are circular in shape.

At the Champion a bell signal system is installed which insures perfect safety and obviates all possibility of error in the transmission of signals to the engineer from any station in the mine. This system was explained in detail in an article by R. H. Bacon which appeared in the *Engineering and Mining Journal* of Aug. 21.

Unique Tempering Furnace

On the surface the machine and tool sharpening shop was inspected. A tempering furnace and conveyor which is in use here embodies some unusual features, including a pyrometer-control forge. It was unfortunate that time did not permit an inspection of the regenerating heating plant. A paper on this subject was read by W. H. Schacht, general manager of the Copper Range Co., at the technical session held that evening.

At the smelters, the straight line and Walker casting machines which are used in connection with large melting and refining furnaces were seen. At the Calumet & Hecla mills at Lake Linden there was much of interest to the mill man: The use of Woodbury classifiers in connection with Wilfley tables, the tailings reclamation and regrinding plant, including leaching and flotation, the 7,500-kw. mixed pressure steam turbines, and the large tailing sand wheels.

To Eagle Harbor for Recreation

Toward noon the visitors headed for Eagle Harbor, where lunch and an elaborate program had been arranged. The first actual copper mining in the Lake Superior district was in 1844, and the first product was secured at Copper Harbor. The trip to Eagle Harbor was through a country rich in the history of the early copper mining of the district, and many of the old mines, now abandoned, were seen. Everyone in the Copper Country swears by the Calumet & Hecla band, and certainly those good people have reason to be proud of their musical organization. During and immediately following lunch the band played several selections that were greatly appreciated by the visitors. The *piece de resistance* of the excellent lunch was Cornish pasties. In the afternoon the visitors were treated to some real Cornish wrestling.

In the evening there were two sessions, one of which was technical and held at the mining building of the Michigan College of Mines, and the other a meeting of the ladies' auxiliary at which Mrs. Dwight presided.

This was held at the college gymnasium. At the session on mine practice, Dr. F. W. McNair presided. The papers "Mechanical Ventilation at the Lake Mine," the "Athens System of Mining," and "Building Reinforced-Concrete Shaft Houses" were all read and discussed by Lucien Eaton. Following the presentation of the last named, William Kelly drew the distinction between shaft houses and headframes. T. L. Condron, a structural engineer of Chicago, discussed the physical structure of concrete in connection with such buildings and pointed out the necessity of taking into account the shrinkage and temperature stresses. H. T. Mercer discussed his paper, "Handling and Treatment of Rock-drill Steel at the Copper Range Mines," and stated that by the adoption of the methods now in use the personal element is entirely obviated. A. C. Paulson, co-author of this paper, explained the pyrometric feature as it is used in the Champion shop. W. H. Schacht, discussed his paper, "Steam Regenerators Reduce Coal Consumption." O. P. Hood stated that the original installation at the Champion mine represented a remarkable achivement at the time, and that recent developments had accomplished a higher percentage of efficiency. He also outlined the coal-saving steps which were adopted by the Government during the war. At the close of the session Dr. McNair introduced President Herbert Hoover.

Mr. Hoover spoke briefly on recent developments in Russia and made a distinction between the Soviet and the Bolsheviki. The situation, said Mr. Hoover, is one which merits the attention of engineers. In closing, Mr. Hoover paid tribute to the people of the Copper Country, the Alumni Association of the Michigan College of Mines, and other local committees which had done so much to make the stay of the engineers a pleasant one. Following this session an informal dance was held at the gymnasium of the Michigan College of Mines. The special trains, one going to the Marquette Range and the other to Iron Mountain, left at 1:30.

Across the Michigan Iron Ranges

THE excursion on the Menominee iron range of Michigan on Wednesday, Aug. 25, was marked by royal weather and a precision of organization and carrying out of plans. The printed schedule which was placed in the hands of the engineers in the morning was followed throughout the day without hitch; and the sun set again at Iron Mountain for them as they returned to their trains at the close of a perfect day. O. C. Davidson, William Kelly, and C. E. Lawrence, prominent Menominee Range mining men, arranged the program, which in the morning included visits to several shafts of the Chapin mine, where the surface installations and underground were inspected, as were the hydro-electric plants in the vicinity, which offer not only engineering attractions, but scenic qualities as well. Luncheon was taken under the trees at the golf grounds, and a busy afternoon was spent visiting the Brier Hill mine and the various shafts of the Vulcan mine of the Midvale Steel Co. Great interest was shown in the various devices for economy and safety and in improved modern styles of change houses, especially that at the East Vulcan, with the overhead system of hanging and drying mine clothes. The electro-hydraulic steam shovel at the Curry shaft of the Vulcan mine, operated by a single man, received a great deal of attention. It is the invention of Frank Armstrong, the mechanical engineer at the Vulcan.

Pioneer Furnace and Chemical Plant Inspected

Engineers who elected to take the Marquette Range trip found much of interest. Arriving at Marquette about 8 in the morning, the visitors were met by automobiles and were taken to the Pioneer furnace and chemical plant of the Cleveland-Cliffs Iron Co. The furnace and also the chemical plant are thoroughly modern; the furnace is equipped with a self-dumping device for the charcoal, has steel ore bins, motor-driven scale cars, skip hoist, and revolving top. In addition to the basic products (wood alcohol, methyl acetone, acetate of lime), the chemical plant produces c. p. acetone, acetic acid, formaldehyde, flotation oils, insulating pitch, sodium acetate, sulphuric acid, iron liquor, methyl acetate, special solvents, hexamethylenamine, and pure creosote. During the visit a pouring of pig iron was made at the furnace for the entertainment of the engineers.

Athens and Negaunee Model Mines

At noon lunch was served at the Wawonowin Golf Club and, following this, many of the visitors indulged in a game of golf. The Athens and the Negaunee mines were visited, and those who wished to do so were permitted to inspect the underground pump room of the former. Both of these mines are models in equipment and the clean and orderly appearance which they present was the subject of much favorable comment.

At the Athens mine the water is raised 2,400 ft. in a single lift by two Prescott horizontal duplex plunger pumps, each having a capacity of 500 gal. per minute. As far as known this is the deepest direct lift installation in the world. At the Negaunee mine a steel stocking trestle was noted. This is supported by circular reinforced-concrete columns placed at intervals of 114 ft. These columns are 6 ft. in diameter at the base and 4 ft. at the top. They are attached to pyramid-shape reinforced-concrete bases 12 ft. x 26 ft. x 6 ft. deep. The reinforcing was made with $\frac{7}{8}$-in. rods, which extend up into the columns for a distance of 20 ft. The length of the trestle is 2,329 ft., with 2,090 ft. available for stocking ore.

On Wednesday evening the two groups, from the Marquette and the Menominee ranges, were reunited at Iron Mountain. Through the courtesy of the Midvale Steel Co., a moving picture film, showing iron ore from mine to finished product, was shown at a local theatre. The various stages of operation were explained by Mr. Richardson, of that company. Following this, William Kelly spoke with respect to an earlier visit of the Institute to the Menominee Range some thirty years ago. Mr. Kelly then introduced Mr. Hoover, who spoke briefly on the engineer's connection with reconstruction problems.

At Minneapolis and St. Paul

UPON the arrival at Minneapolis, many of the members went to the Curtis Hotel, the temporary headquarters in that city. At 10 o'clock the technical sessions at the University of Minnesota commenced, and were as follows:

Session on Mine Practice, Herbert Hoover presiding; session on Geology and Resources, W. H. Emmons, presiding; session on Oil and Gas and on Non-Ferrous Metallography, C. E. Julihn presiding. At the session on mine practice, A. J. Strane presented his paper on "Modern Commercial Explosives and Their Uses." Robert Linton in presenting a discussion of his paper, "Standardizing of North Butte Mining Co.," used a number of stereopticon as well as cinema views, thereby adding greatly to the interest of his paper. The plan now in force at the North Butte has been most successful in securing efficient results, and the methods employed have the full confidence and approval of the men.

The paper, "Mining Methods and Costs at the United Verde Mine," by H. De Witt Smith and W. H. Sirdevan, was read by Mr. Smith and was illustrated by stereopticon views. F. A. Wildes, State Superintendent of Mines, outlined the work of his department in keeping in touch with the work done by operators on state properties. This department maintains a full corps of mining engineers and assistants.

Oil and Gas To Be Discussed at St. Louis

The other papers included in the session were omitted owing to lack of time. There being no discussion at the session on Oil and Gas, this was postponed until the St. Louis meeting, when it is expected that matters pertaining to those subjects will be fully considered.

At the geological section, over which W. H. Emmons presided, the first paper, "The Dip Needle in Stratigraphy," was presented by the author, H. R. Aldrich, and attracted considerable discussion. The possibility of the further use of the dip needle, even outside of the iron regions, in detecting and following formations beneath a moderate thickness of overburden, was discussed by the author and by W. O. Hotchkiss, and the necessity for caution was emphasized by Carl apffe. The paper on "Exploration Methods on the Gogebic Range," given by Mr. Hotchkiss, was concise and convincing in its delineations of the various factors controlling ore deposition on the Gogebic and the most economical and efficient methods of exploration by diamond drilling and crosscutting. In debate, Mr. Hotchkiss was praised for the spirit he had shown in making public these valuable criteria, which had resulted in substantial saving at various properties.

The paper on "Application of Ball Mills in Southeastern Missouri," by Lewis A. Delano and Harold Rabling, was read by title, the authors not being present, but Mr. Greenfield presented a carefully prepared comment, touching in turn the various features of the original paper. The paper on the "Geology and Ore Deposits of the Jerome District, in Arizona," was presented briefly in abstract by Mr. Harper for the author, Louis E. Reber, Jr., who was absent. This is the geology of the United Verde and neighboring mines, and so is of great interest. The ore deposits are pre-Cambrian, and presumably genetically connected with a batholithic intrusion which outcrops in a neighboring area.

While at the University of Minnesota, many of the engineers visited the Mines Experiment Station, on the college campus, where a magnetic concentration test was in progress throughout the day. The test included magnetic cobbing at coarse sizes, followed by fine closed-circuit grinding in a ball mill, with concentration in a magnetic log washer, dewatering in a continuous filter, and sintering.

For the purpose of organizing a chapter in the Twin Cities, Mrs. Arthur S. Dwight, president of the Woman's Auxiliary of the A. I. M. E., met the ladies who are members, and those who are interested, at the home of Mr. and Mrs. H. V. Winchell at 10 o'clock on Thursday morning. Mrs. Dwight explained the activities of the auxiliary, but no steps were taken for the formation of a definite chapter, although Mrs. Winchell was appointed temporary chairman.

Senator Kellogg Speaks

The noon lunch was held at the St. Paul Hotel, St. Paul. U. S. Senator Frank Kellogg was introduced, and gave a short talk on the visit of the engineers to northern Minnesota. Following Mr. Kellogg, the Rev. Mr. Ferguson, who represented the Mayor of St. Paul and who is a member of the City Commission, bade the engineers welcome and paid a splendid compliment to Herbert Hoover for his work during the war. Mr. Hoover spoke briefly on industrial relations and expressed the appreciation of the engineers for the reception that had been tendered them. After the luncheon, automobile parties were formed and the visitors were taken to various points of interest in the Twin Cities. Several of the members played golf at the Interlaken and the Town and Country clubs. Among points of interest visited were the various flour mills and the plant of the Minneapolis Steel & Machinery Co. This company has constructed some of the largest mills and smelters in this country, and is now building the magnetic separation plant at Babbitt, on the eastern Mesabi Range. Some of the members visited the display rooms of the W. H. Ziegler Co., where an exhibit of mine railway equipment and supplies was shown.

The banquet, held Thursday evening at the Curtis Hotel, was preceded by an informal reception in the parlors. Immediately after being seated the guests were surprised to have all the lights extinguished, and a blaze of light at one end of the hall made it evident that several miners, dressed in slickers and wearing the regulation iron-country underground hats, had entered the room. The "miners" burst into song, and following that distributed a number of unique ash trays bearing the seal of the A. I. M. E. These were made and presented by the F. C. Orn Iron Co.

In introducing William C. Edgar, former editor of *The Bellman*, and now editor of the *Northwestern Miller*, Phillip N. Moore, past president of the Institute, announced his function as that of "introducer of introducers." Mr. Edgar acted as toastmaster in a most able manner and soon demonstrated his ability to ap-

pear at home in any company even though he is not an engineer. Fred B. Snyder, president of the Board of Regents, University of Minnesota, was the first speaker, and he outlined the history of the state, calling special attention to the importance of Minnesota as a flour center and as an iron producer. He mentioned the subject of the tonnage tax and spoke of this as being one of the factors that might hamper development of Minnesota's iron-ore resources, unless steps were taken to keep this tax within reasonable limits. He also spoke of the beneficiation work that is being done at the experimental school and elsewhere.

Mr. Edgar then introduced J. E. Spurr, Editor of *Engineering and Mining Journal*, who responded in a light vein. Mr. Spurr said that he was called in as a substitute for Mr. Winchell at the last minute, having been advised of his departure for Alaska only a few days before. Mr. Spurr told of some of his early experiences on the Mesabi Range and outlined the difficulties under which the pioneers worked. John E. Hodge, local committee chairman, then read a telegram from Horace V. Winchell to Mr. Hoover, in which Mr. Winchell congratulated him on his accomplishments and stated that the Institute might indeed be proud to have Herbert Hoover as its president.

In introducing Mr. Hoover as the next speaker, Mr. Edgar referred to him as "the greatest living American." Mr. Hoover chose as his subject the establishment of a Department of Public Works and said that such a step is necessary to a broad-visioned national guidance. Engineers must, said Mr. Hoover, exert themselves in engineering policies, and so bring about the proper co-ordination and co-operation of the various engineering functions of the Government.

The engineers' special train left the Union Depot at Minneapolis for the Mesabi Range at 11:30 p.m.

Mr. Snyder's Address

In his opening address, Fred B. Snyder spoke in part as follows:

Minnesota lies in the heart of the continent. The early voyageur could pass by water and short portages from the Gulf of Mexico by way of the Mississippi, Minnesota and Red rivers to the Arctic Ocean and by way of the Mississippi, St. Louis and St. Lawrence rivers to the Atlantic Ocean. The New England States could be laid upon her surface, and there would be enough of Minnesota left over to cover half of Pennsylvania. If the waters of her inland lakes could be gathered together, Delaware and Rhode Island could be submerged and leave to view only islands marking the high spots.

Doubtless the industry of Minnesota which most interests you as mining engineers and metallurgists is that of iron. There are, as you know, three iron-bearing ranges in Minnesota, the Vermilion, the Mesabi and the Cuyuna. Of these the greatest is the Mesabi. I would not if I could, burden you with a discussion of its geology. It is a flat, not vertical, formation covered by a shallow surface of glacial drift, susceptible by test pitting and drilling, of very accurate determination as to tonnage, metallic content, and structure, in advance of opening up. One-half of the ore in the Mesabi Range is subject to open-pit steam shovel mining at very low cost. Today approximately 70 per cent of the ore produced is won by open-pit methods and the remainder from underground operations where ore is cleanly mined with less than 5 per cent loss.

Work of Winchell and Spurr Praised

The first published scientific data about the Mesabi was issued under the State Geological Survey conducted by the University. N. H. Winchell was at the head of the survey, and he was ably assisted by his son, Horace V. Winchell, who was president of this organization last year, and J. E. Spurr, both of whom have achieved distinction in geological work.

The Mesabi Range has been the controlling raw material factor in the iron markets of the world since the true values of its ores became known. It made possible the organization of the United States Steel Corporation and the entrance of the United States into the steel markets of the world. Many furnaces in the valley districts have been remodeled or built to use exclusively Mesabi ores.

The extent of this influence may be gathered from the following data furnished by O. B. Warren, whose reputation as an authority on all questions relating to the iron ore resources of Minnesota entitles him to full credit. During the three-year period ending with 1917 the United States produced an annual average of 35,000,000 tons of pig iron, which required 70,000,000 tons of iron ore, and was one-half of all the pig iron produced in that period in the world. The increase in production of pig iron in the United States has been far greater than in other countries. This result can be traced largely to the influence of the Mesabi Range.

Mesabi Range Production

The first ore from the Mesabi Range (4,245 tons) was shipped in 1892. The annual average for the three years ending 1907 was 24,000,000 tons and for the three-year period ending 1917, 38,000,000 tons, out of a total of 70,000,000 tons, the yearly average consumed during the same period in the United States from all sources. The United States will annually need from all sources on the average for the three years ending 1927, 101,000,000 tons; for the three-year period ending 1937, 124,000,000 tons and for the three-year period ending 1947, 129,000,000 tons. To produce her proportion of this ore the Mesabi must annually yield on the average for the three-year period ending 1927, 60,000,000 tons; for the three-year period ending 1937, 74,000,000 tons. Then, gentlemen, witness the astonishing result: The Mesabi will have passed the peak of her load and during the last three-year period ending 1947 she will be able to produce only annually 55,000,000 tons. In other words, making allowance for all known ore reserves on the Mesabi and adding thereto 500,000,000 tons for new discoveries, the maximum burden on the Mesabi Range will be reached in less than twenty years. When that day comes, indeed in anticipation of it, the supremacy of Minnesota as an iron-

producing state will have passed unless something is done to change the situation, because furnace men in anticipation will seek supplies in the old ranges in Wisconsin and Michigan and in Sweden, Spain, Chile, Cuba, Brazil or elsewhere, and docks, plants and equipment will be permitted to wear out without new replacements.

And now a word about the ad valorem system of taxing iron properties in vogue in this state. Under the Minnesota law all real estate is valued at its true value, and then for the purpose of taxation is placed upon the tax books at 50 per cent of such value in the case of iron ore, 40 per cent in the case of city property, and 33⅓ per cent in the case of farm property. Doubt has been expressed about the method employed in the various taxing districts of the state for ascertaining the true value of property other than iron ore, but there can be no doubt as to the method employed to determine the value of iron ore. As to this class of property the data of all explorations, the results of test pitting and drilling, with accurate and complete blue prints, must be filed with the Minnesota Tax Commission, which submits the same to the School of Mines for a scientific determination of the tonnage and grade of the ore. The property is then assigned by the Tax Commission to a certain class, based upon the immediate or deferred availability of the ore deposit, and its value for taxation purposes ascertained by multiplying the tonnage by the rate per ton fixed for the class in which the property is placed. As a result of this system iron ore pays enormous taxes, in some cases as high as 60c. per ton on the average annual output of the mine. And yet there are those who clamor for an added or super-tax in the nature of a tonnage tax on the ore as it comes to the mouth of the mine.

I consider the present method of mineral taxation in Minnesota one of the greatest drawbacks to the maintenance of the supremacy of Minnesota as an iron producer beyond the year 1940, for the following reasons: There are many strong magnetic attractions running parallel with and lying north of the Cuyuna and Mesabi ranges and extending to the Dakotas and the Canadian border. These and unexplored available land near the known ranges should be explored, and would be were it not for the fact that the finding of an orebody is penalized by the imposition of taxes too burdensome for individuals to carry. After diligent inquiry I cannot learn of a single drill now at work by private exploration enterprise seeking iron ore in Minnesota. Individuals who now own iron-ore properties which they have developed in the past are, unless they have large outside resources, forced either to become operators, in which case the price of their ore is fixed in Cleveland, and they have no chance, without transportation and furnace facilities, to make up a loss in operation, through profits on the pig iron or finished product—or they must dispose of their property to the large Eastern corporations. Thus all individual initiative is throttled. Iron ore in Minnesota will be mined and removed as fast as possible while reserves in other states where taxes are less burdensome will be held for the future. These objections will all be made more evident if a tonnage tax is added to the present burdensome ad valorem taxes.

The Address of J. E. Spurr

The remarks of J. E. Spurr follow, in part:

Some men are born eloquent, like Mr. Bradley Stoughton; some, like Mr. Hoover, achieve eloquence; and some have eloquence thrust upon them. I do not belong to any of these groups, but of all I come nearest to the third. While we were plowing the placid waters of Lake Erie Stoughton came to me with a telegram indicating that our honored past president, Horace Winchell, had some time before set sail for Alaska, and had designated me his literary, scientific, and post-prandial executor, appointing me his proxy to represent him in and for Minneapolis. I said to Stoughton, "Why did Winchell think I should represent Minneapolis?" "Oh," he said, "It's a very good choice; you could pass for a Swede anywhere." I protested that I had not brought my dress suit. I have had a number of cards printed, addressed to myself, which I shall distribute after the exercises, and if you will put your name and address on one and send it to me I will mail you a picture of my dress suit. You can thereby assure yourself that I have a perfectly good dress suit, of the vintage of 1902, with additions of the Roosevelt period.

Anyhow I have had some very pleasant experiences since then, that have partly compensated for the mental anguish I have suffered between then and the present moment. You know it is a very pleasant thing to be distinguished and popular. I attended the picnic at Eagle Harbor the other day, for example, and I noticed a lady regarding me with the greatest of interest. Finally she spoke to me. "Would you mind," she said, "stepping a little to one side? I want my little girl to see Mr. Hoover."

Now, as a personified proxy, how shall I represent my principal, Mr. Winchell? I am convinced that he did not designate me because of any personal resemblance; but possibly because I long ago spent a year in Minnesota, saw and experienced intensively some of the rough and early days on the Mesabi Range, and was domiciled for a while in Minneapolis. He knew that I knew that Minneapolis is not a suburb of St. Paul. He remembered that at one time we both qualified among the champion bean eaters of the North Country. You know that is one of the hardships of New York, for anyone who was born near Boston and educated in Alaska, with a prep-school course in Minnesota: there isn't a decent beanery in the whole town. They have an Engineers' Club in New York, but I blush to say that you can't get bacon and beans there. Not much like the old Palace Hotel in Tonopah, where they tried to put on style. They had a restaurant, bar-room and roulette game downstairs and six bedrooms upstairs. They had one waiter, who was a graduate of Oxford, and very punctilious. A stranger sat near me one day, and this waiter was altogether correct. "Yes sir. Dinner will be ready in a moment, sir." And then, "Dinner is served sir. Will you take beans, sir?" "No, I don't care for beans." "In that case, sir, dinner is over, sir."

I confess that it gives me a peculiar satisfaction to be able to attend a function of this distinguished asso-

ciation of mining engineers in Minneapolis, and still more to visit once again the great Mesabi iron-bearing range.

I shall not soon forget the Mesabi. And very particularly do I remember Hibbing. Three of us had made a reconnaissance as far south as Cloquet, and when we left the range the furthest place westward which had been cut out of the forest, so far as we knew, was Mountain Iron. Striking north from Cloquet late in the fall, with packsacks, we followed an Indian trail northward. About the time our grub gave out the trail ended in a little lake; and this lake was not frozen thick enough so that we could travel over it, so we started around it northward through fallen timber. It became very cold that night and we huddled around a fire most of the night to keep from freezing. Next day we unexpectedly came to a line which had been newly cut for a railroad, and following along it we discovered the town of Hibbing, which we had never heard of before.

It was a wide-open town, half the population had typhoid and the other forty danced all night in the hotel. The saw and the hammer were going on very busily here; there was already a hotel. The hotel had two rooms: a combination bar and dance-hall downstairs and a bedroom upstairs. One of our party lit out for the East and the other two of us took a bed in the bedroom and tried to sleep. There were a score of beds in the room and no doors and no lights; and as soon as we went to sleep the revelry started in the room below. There would be a dance, a round of drinks, a fight, another dance and so on indefinitely. Whenever a man got too drunk to dance he started for bed and climbed into the first bed at the head of the stairs. This happened to be ours—we kicked him out and he went to the next bed and crawled in with his boots on. Pretty soon the next man came up, and crawled into our bed, was kicked out, and came to anchor in the third bed. In the course of time the next one made the rounds of the first, second and third beds, and finally found peace in the fourth bed. It was not a quiet proceeding either, and when the dawn came the game was still going on and we had not closed an eye.

We got up and traveled down the board sidewalk that was laid on top of the stumps, and we came to a house that a man was putting up for himself. He had one room finished off, and in the corner there was a pile of the nicest, loveliest shavings you ever saw. We asked him how much he would charge to let us spread our blankets on these shavings, and he said, "Go ahead." The weather was zero, but I never saw a hotel that looked more luxurious to me. Looking at it now, however, I can say to you gentlemen from Hibbing, if there are any here tonight, that I don't like your hotel accommodations.

Mr. Hoover's Address

HERBERT HOOVER'S address at the banquet of the American Institute of Mining and Metallurgical Engineers, at the Curtis Hotel, Minneapolis, on the evening of Aug. 26, was in full as follows:

The time has arrived in our national development when we must have a definite national program in the development of our great engineering problems. Our rail and water transport, our water supplies for irrigation, our reclamation, the provision of future fuel resources, the development and distribution of electrical power, all cry out for some broad-visioned national guidance. We must create a national engineering sense of provision for the nation as a whole. If we are to develop this national sense of engineering and its relations to our great human problems it must receive the advocacy of such institutions at this.

We, together with our sister engineering societies, represent the engineers of the United States. It is our duty as citizens to give voice to those critical matters of national policy which our daily contact with this, the fundamentally constructive profession, illuminates to us. Just as our medical associations voice the necessity of safeguards to national health; as the bar associations safeguard our judiciary, so the engineers should exert themselves in our national engineering policies. We have none, but we need some, or the next generation will face a lower instead of a higher standard of living than ours.

Must Co-ordinate Development

The development of our transportation, fuel, power and water under private initiative has been one of the stimuli that have created the greatness of our people. It has been easy to compass when the problems were more local and filled with speculative profits. There, however, arises a time when this haphazard development must be co-ordinated in order to secure its best results to the nation as a whole. This system has given us a 50 per cent result; if we are to have 100 per cent we must have a national conception and national guidance. This last 50 per cent involves problems beyond individual initiative alone.

Not only is individual initiative insufficient because the problems involve political, financial, interstate matters beyond corporate ability, but we have, with practically unanimous consent of the country, adopted a policy of the limitation of profits in the operation of public transportation and power and some other utilities, and through the pressure of public opinion we are rapidly coming to a limitation of profit in the development of other large sections of national resources which tend to become natural monopolies. While the limitations of these profits makes for public good, on the other hand they also militate against individualistic development of national resources and necessitate the co-operation of the community as a whole to secure initiative for wider development in the national sense.

Conservation Is National Concern

Certain of our national resources have always been in national ownership, such as waterways. Certain others, such as reclamation, irrigation, distribution of water for power, are rapidly coming under Government control. In others, such as timber, coal, and oil, the possible exhaustion brings their conservation or provision for the nation's future into national concern. In our railway

problem national action has until recently been directed wholly to limitation of profits. Latterly it has undertaken to regulate wages and give some small recognition to the necessity of equipment. But microscopic attention has been given to the greater problem of how to get more transportation, to get it so organized as to secure real economic operation in its broad sense.

We have a long list of such problems. Some of these have been discussed before the Institute on previous occasions. I may refer to our discussion of eastern bituminous coal. During the past year the Institute undertook to look into the economic situation of this industry as a national whole. It was demonstrated to be the worst functioning industry in the country. Owing to seasonal and other irregularities of demand, the average term of employment in the bituminous industry is less than 190 days per annum. If this industry could be operated a normal work year 125,000 men could be turned to other production. It is an industry in which 30 per cent more capital is invested than would otherwise be necessary. The cost of coal to the consumer and the risks to the operator are greatly increased, and, above all, it presents a great human problem fraught with all the terrible misery and strikes and justified discontent that flow from intermittent employment.

Solution Beyond Individuals

I am not proposing nationalization of the coal mines; far from it. What is required is that we should realize that with our necessary social view of prohibition of combination there remains a national problem beyond the solution of any individual coal operator or any group of operators. It must have national guidance and national plan for its solution, a co-operation of great consumers, railways, operators and miners—but what individual operator can do this?

In respect to our coal supplies again, if we would look forward to the next generation, we have a problem of conservation of immense importance. In this connection, it has been ably proposed by our members that the national government should co-operate in investigating the possibilities of the establishment of a great electrical trunk line throughout the great power consuming districts of the northeast, and that we should feed into this great power road power generated at the mines and available water sources, drawing from it at every town and city. The consummation of this project means cheaper power to all consumers. It means a great economy in consumption of coal. It means more regularity in output. It thus means greater ability to compete in world manufacture. It means great relief to the railways from expansion. It means an increased standard of living and a decreased cost of living to a very large section of our population. We have again much such a problem in providing adequate power resources upon the Pacific Coast, where today hundreds of thousands of acres of fertile land are practically non-producing for lack of pumping power.

Mountain Water Storage Problems

Of other problems akin to this, we are confronted throughout the west with the fact that a large portion of our average low water supply is already under engagement for irrigation and power. The time has come when that expansion of the land available for cultivation, or into more intensive cultivation, is a factor of mountain storage of water to increase our stream flows in the low season. We have thus a storage problem on a scale we have not hitherto dreamed of, and, again, it is a problem involving co-operation in financial, economic, distribution, navigation—interstate questions, in which individual initiative must have the assistance of the community.

Another series of such problems lies in our oil supplies. If we are to have a mercantile marine and to maintain our navy on a basis of equivalent efficiency with foreign navies, if we are to maintain the development of the gas engine—the greatest lift in our standard of living and saving of labor in fifty years—we are confronted with the necessity of securing additional oil supplies from outside our own boundaries. Our own supplies, so far as now known, do not represent twenty-five years at our present rate of consumption. The Institute many months ago was the first to give warning to the Federal Government of the gradual absorption of all of the oil sources of the world by other great powers, and that within a short time we should be dependent upon the good will of those powers for our necessary oil supplies. No private individual can compete with foreign governments in the measures that they are adopting to hog the resources of the world. This problem again is an engineering problem that requires more than private initiative.

Transportation Tax Heavy

A problem of even more pressing importance than these is the whole question of transportation. Our inability to move the commodities which we create is stifling production. It is increasing the cost of distribution and has placed a tax on the American people in decreased production and increased cost of distribution greater than all the taxes imposed by the war.

We have today in Minneapolis ample proof of the frightful cost imposed on the farmer, consumer and public. There is a premium over freight cost from 10 to 20c. a bushel for wheat at the mill door compared to wheat in the elevator a few hundred miles away, solely because cars are not available. Either the farmer is losing the amount or the consumer is paying it. Furthermore, to carry the picture further, the railways, in endeavoring to remedy this, are diverting cars from the lumber industry. Already certain mills are partially closed; men are thrown out of employment in the mills and in the building trades. Is this not a price in human misery and national efficiency that warrants some national concern? It is a problem that does not lie alone in expansion of railway facilities. It lies also in the proper expansion of waterways and their co-ordination with the railway transportation of the country.

Congressional Waste

We have been dabbling in the improvement of water transportation of the United States for 100 years, and so far as I know never yet have we considered it as a problem requiring complete co-ordination of the entire transport problem for the whole country. We have spent enough money improving useless creeks to have made several competent waterways. Every Congressional district in the United States has looked for appropriations for carrying mud from one hole to another as their proper participation in the national plunder. They have never considered that the taxes taken from the people as a whole should be devoted to those points that will benefit the people as a whole.

One result of the policy pursued has been that our waterways have been so badly handled that they have not been able even to compete with the railways, and today, with an enormous increase in railway rates, we find ourselves utterly unable to handle the great bulk commodities of the country at the possible lower charge over our waterways. The opening of the St. Lawrence to ocean-going vessels means 5c. a bushel to every farmer in ten states. Likewise, of no less importance to the people of the entire country are our internal waterways.

These projects have a simple result in the engineer's mind: they make greater production possible with less human effort; they increase the standard of life; they provide for our children. All these problems are much akin, and the time has come when they need some illumination, guidance, and co-operation in their solution from the Federal Government. Nor do I mean a vast extension of Federal bureaucracy in Federal ownership. If, in the first instance, through an agency of the central government, we could have an adequate study and preparation of plan and method made of these problems of engineering development over the next fifty years, viewed solely in their national aspects, we would have taken the first step toward the adequate provision of an increasing standard of living and a lower cost of living for our descendants.

The second step is to determine that our government will be a government of co-operation, limiting profits surely, but holding to individual initiative as the single hope of human development. In order that we shall have some central point in the Federal government where these problems may be adequately considered, from which they can be ventilated for the verdict of public opinion, where the business brains of the country can be called into conference and co-operation with the government, and therefore with the people, the engineers of the United States have proposed time and again that a Cabinet department should be established in Washington, either new or to replace the Interior Department, to which should be assigned the whole question of public works.

You are familiar enough with the advantages of such a department from an everyday administration point of view, and enormous saving to the government from the duplication or competition of the six or seven departments now engaged in engineering construction work of this character, but on this occasion I wish to call your attention to the fact that such a department has become an essential from the point of view of proper consideration and presentation to the American people of these broader national engineering problems, upon which the next generation must depend if our country is to march forward.

Duluth and the Mesabi Range

THE special train arrived at the Leonidas mine at 8 and the visitors were met by members of the Engineers' Club of Northern Minnesota, under whose auspices the entire trip of the Mesabi Range was made. A. Tancig, president of the club, was in general charge of the arrangements, and the various committees were headed by members. The carrying out of all the details was characteristic of the way Minnesota people have of doing things, and the entertainment arranged was complete in every particular.

The Leonidas Concentrator

At Leonidas the party was joined by a number of the officials of the Oliver Iron Mining Co., who made the trip from Duluth by special train. Among these were J. H. Hearding, George D. Swift, and also E. E. Hunner, of the M. A. Hanna Co. As soon as the crowd was assembled parties were made up and the visitors were taken through the Leonidas concentrator. This plant has a capacity of 2,500 tons per ten-hour shift and has a total rated motor capacity of 992 h.p. The water is supplied from Manganika Lake, one mile from the plant, through 12-in. spiral riveted pipe by two 8-in. two-stage centrifugal pumps. The pumps have a capacity of 1,600 gal. per minute each, and are driven by 150-hp. motors. The washing is accomplished by means of a 35-ft., Hutch type, Allis-Chalmers log washer operated by a 50-hp. motor. From the washing plant the visitors were taken by automobiles to Virginia, where an inspection of the Virginia & Rainy Lake Lumber Co.'s mill was made. This mill boasts of being the largest white-pine mill in the world, and has a capacity of one million feet per day.

Before returning to the special train, which was temporarily parked near the headquarters of the Oliver Iron Mining Co. at Virginia, several of the members of the party visited the neighboring mines. At the Missabe Mountain mine, one of the 350-ton steam shovels was seen in operation. Dump cars which are operated by compressed air and have a capacity of 20 cu.yd. are used here on stripping operations. At the Alpena mine the visitors had an opportunity to see an open pit in its last stages, for here all of the steam-shovel work has been completed and the little ore remaining is being removed through the shaft.

Some of the members motored east to Babbitt, where the Mesabi Iron Co. is erecting a mill for concentrating and treating low-grade iron ores on the Eastern Mesabi Range. The initial unit of the plant under construction will have a capacity of 3,000 tons of ore per day, and it is estimated that about three million dollars will be spent in the erection of the plant and the establishment of the town site. The work is in charge of W. G. Swart, and the construction is being done by the Minneapolis Steel & Machinery Co.

The greater number of the visitors were taken to the western portion of the Mesabi Range. The first stop was made at the Wabigon mine, where a 300-ton electrically-operated shovel was in operation. At the Shenango mine the visitors were treated to a little excitement in the form of blasting. A number of blasts were shot off, which demonstrated the methods generally used in open-pit practice. It was impossible to include in the itinerary a trip to the Buffalo pit, as originally planned, owing to some of the delays which had been incurred en route.

Upon reaching the Oliver headquarters at Hibbing the visitors boarded flat cars and were taken through the Hull-Rust, Mahoning, and Sellers mines. During this trip the engineers had ample opportunity to view the up-to-date methods which are used in open-pit practice. All-steel air-dump stripping cars of 20- and 30-cu.yd. capacity are used; and 91-ton steam shovels, having 4½ to 5-cu.yd. dippers, which have a capacity of 9,000 tons per ten hours, as well as 350-ton shovels, having 8 cu.yd. dippers, which can move 10,400 tons per ten hours, were seen in operation. The tracks are laid in 30-ft. sections by a wrecker, the ballasting is done by means of a clam-shell, and the ties are tamped into place by gasoline-driven air tampers. On the stripping dumps the tracks are shifted by means of wreckers and track-lifters, and the dumps are leveled by spreaders.

Returning from the pit, members of the party were driven to Bennett Park, where an elaborate lunch had been prepared, and this was followed by a band concert. Afterward, the ladies of the party were taken to the Public Library and there inspected the building which embodies features seldom seen in mining communities. In addition to an excellent library there is a complete stage equipment; a model flat, completely furnished, is on exhibition, and other features which encourage a community spirit are in evidence.

THE TECHNICAL SESSION

The technical session, which was held at the Lincoln High School, was presided over by W. G. Swart. The first paper, "Utilization of Titaniferous Iron Ores," by J. A. Heskett, was presented by title only, and no discussion followed. "Casting and Molding Steel Ingots" was read by the author, Emil Gathmann. There was a little discussion following this, but it was largely on the use of castings. Secretary Stoughton stated that the presentation of the papers of the evening was perhaps out of order, considering the fact that there was little of interest to the iron-ore miner, but there had been, he said, no papers offered from that section for this year. He expressed his appreciation of the excellent arrangements which had been made by the Engineers' Club of Northern Minnesota for the reception of the A. I. M. E. Following the presentation of the paper, "The Acid Bessemer Process," by Richard S. McCaffery, there was some discussion by Mr. Stoughton and Prof. Joseph W. Richards. The last paper, "A New Occurrence of Proeutectoid Ferrite," was commented on briefly by the author, Charles Y. Clayton, and was discussed at some length by E. E. Thum, of *Chemical and Metallurgical Engineering*. Following this session an athletic program was held at the armory.

During the small hours the special was moved from Hibbing to Coleraine, and immediately after breakfast the visitors were taken on flat cars to the Canisteo pit, where part of the ore now being treated at the Trout Lake concentrator is being mined. They were then taken to the concentrator. The Trout Lake concentrator has a capacity of about 20,000 tons per day, with all units operating. The machinery is arranged in five units, each complete and capable of independent operation. Each unit consists of the following:

One crude ore bin and one bar grizzly.

One 20-ft. conical revolving trommel with 2-in. openings.

One picking-belt, to receive and convey the trommel oversize to the concentrate bin. (The taconite chunks are picked off the belt by hand and dropped into a rock bin.)

Two 25-ft. log washers, one on either side of the trommel to treat the trommel "throughs," discharging a product into the concentrate bin.

Two chip-screens, one for either "log," receiving "log" overflow.

Two settling tanks receiving chip-screen "throughs."

Two 18-ft. "turbos" (small log washers to treat fines), receiving the tank settlings, discharging a concentrate directly into the concentrate bin.

Four settling tanks receiving the overflow from turbo and first settling tanks.

Twenty Overstrom tables, arranged in two rows of ten each, to treat the settlings from the four settling tanks just mentioned.

Eight Frenier spiral sand pumps (four primary and four relay), to pump the table concentrates to dewatering tanks from which they discharge directly into the concentrate bin.

At 10 a.m. the party took the special train which had been switched to the tracks at the lower end of the concentrator, and at 1 o'clock Duluth was reached. Immediately upon the arrival of the train representatives of the Engineers' Club of Duluth assigned various parties to several optional trips, all of which were well attended.

At 5 all the parties were on the steamer "Rotarian" for an excursion through the beauties of Duluth Harbor, with its various industrial monuments. This trip took till nearly 9 o'clock, and was the occasion for a general final fraternizing in the spirit which marked the whole meet. A choice of box luncheons was served, a "Mining Lunch" and a "Metallurgical Lunch." The former was the more substantial, though the latter was more delicate and with a couple of extra frills. The State Geologist of Wisconsin, who disappeared with eight "Metallurgical Lunches," established the further formula that eight metallurgical lunches equal one geologist's lunch.

On landing the party split, some to return to Chicago at 9 p.m. by special train, on which the same perfection of arrangements was observed, and part to return to Buffalo by the Lake steamers.

The smoothness of the arrangements and the conduct of the whole trip of the Institute in the Lake Superior country was evidently largely due to the energy of the able Secretary of the Institute, Bradley Stoughton, and his well-chosen aide, J. T. Breunich.

THE "HAND BOOK OF MINING"

A write-up of the A. I. M. E. trip would be incomplete unless some mention were made of the various programs which were prepared by the local committees at each point. These were, in every case, most elaborate and represented painstaking preparation on the part of those who had the work in charge. Of intense interest was the "Handbook of Mining," which was prepared jointly by Alexander N. Winchell, the Engineers' Club of Northern Minnesota and the Duluth Engineers' Club. The book consists of 260 pages, is well illustrated with photographs and maps, and contains a wealth of data concerning the districts visited. These were distributed at Buffalo as the party were starting on the Lake trip. Covering every phase of mining, milling, and metallurgy in the Lake Superior district, in addition to other facts, the book proved to be a veritable Bedaeker and was in constant use as a reference.

Mining Methods and Costs at the United Verde Mine

BY H. DEWITT SMITH, E. M., Jerome, Ariz., and W. H. SIRDEVAN*

THE mine operated by the United Verde Copper Co. is situated near Jerome, Ariz., at an elevation of approximately 5,500 ft. above sea level. From the time of its location, in 1876, until its purchase by Senator W. A. Clark, of Montana, in 1889, the United Verde mine was worked on a small scale, and shipments of high-grade gold-silver ore were made from the surface workings. The approximate total amount of ore mined up to the end of 1918 is 8,200,000 tons. The production of the five years, from 1914 to 1918 inclusive, represents 40 per cent of the total mine ore production..

For the convenience of smelter operation, the ores mined are divided into four classes, each of which must be handled separately in all mining operations. In addition to these ores, a small amount of precipitate is recovered from the copper-bearing mine waters and shipped directly to the smelter. All present exploration and development work, stoping methods, tramming, hoisting, and ventilation systems, are planned with the definite purpose of providing and maintaining an underground production of 3,000 tons of ore per day, with the possibility of a further increase to 4,500 tons per day, if mine and market conditions should warrant this additional output.

To maintain an underground production of 3,000 tons of ore per day, it is necessary to develop 100 ft. in depth every year, and to drive 25,000 ft. of drifts and raises for exploration and development work. During the last few years, an average of thirty-four tons of ore has been developed per foot of development work. This high figure has been due to the character of the orebodies, which are large, persistent, and concentrated within a relatively small area. This advantage is partly offset by a high average cost for all exploration and development.

WORKING THREE SHIFTS, BUT A FOURTH NOW BEING CONCRETED

At present there are three working shafts at the United Verde mine. These are called No. 3, No. 4, and No. 5. A fourth shaft, No. 6, is being concreted and should be in operation by December, 1920.

The most economical interval between levels has been found to be 150 ft. A closer spacing increases proportionately the cost of level development per ton of ore mined. In mining under a filled stope, it is necessary to extract three or four floors directly beneath the level by the use of square sets, a more expensive mining method than the horizontal cut-and-fill method generally used for the remainder of the stope. With a level interval of 100 ft., approximately 20 per cent of the total ore must be mined by the square-set method, whereas the corresponding ratio is only 15 per cent when the level interval is 150 ft.

A 200-ft. level interval (1,000 ft. to 1,200 ft.) was found unsatisfactory. The increased cost for raise development, the high cost for maintenance of the ore chutes in the stopes, and the necessity of providing a sublevel for development halfway between the two levels, more than offset any advantage gained by using the longer lift.

On account of the difficult drilling ground at this mine, it has proved economical to place all drilling operations under the supervision of one engineer. His duties may be enumerated briefly as follows: (1) To keep a detailed record of all drills underground and to see that they are kept in the best working condition; (2) to test new types of drills as they are received from the manufacturers; (3) to record and analyze the work accomplished by the drill bits; (4) to see that the type of round best adapted to the class of ground being drilled is used in all development work; and (5) to carry on experimental work relative to air pressures, hose, hose connections, valve designs, and other operating factors.

Formerly the bottom cut was used exclusively, whereas in the present practice the pyramid cut is standard for all drift rounds from a clean set-up. The bottom cut is still used whenever it is necessary to set up a crossbar before the drift has been cleaned out, as it requires the drilling of only two or three holes from the lower set-up.

DIAMOND DRILLING

Diamond drilling at the United Verde mine serves two purposes: long holes are drilled to determine the different geological formations, and massive sulphide areas are developed and blocked out by numerous short holes. It has been found that the diamond-drill cores from schist areas cannot be relied on for accurate data on the mineralization. Consequently, the drill is used to locate and determine the size of schist areas, and the actual development is performed by drifts and crosscuts. The assays of cores from the massive sulphide areas have been found to check closely with subsequent drift development work. For this reason, and because of the high cost of drifting in such areas, exploration of the massive sulphide areas and the delimitation of the boundaries of large sulphide orebodies are usually done by diamond drilling.

STOPING

The stoping methods and their relative importance are given in the accompanying table. The relative importance of these methods is rapidly changing at this time (December, 1919).

STOPING TONNAGE AT UNITED VERDE MINE, 1918

Method of stoping:	Dry Tonnage Mined	Per Cen of Total
Horizontal cut-and-fill	468,000	58.5
Incline cut-and-fill	11,200	1.4
Square-set and fill	68,000	8.5
Shrinkage and fill	117,000	14.6
Glory hole	136,000	17.0
Totals	800,200	100.0

Glory-hole mining will be abandoned in favor of open-cut steam-shovel mining early in 1920. No ground has been developed recently on the lower levels that will permit the use of shrinkage methods. Consequently, in future work, horizontal cut-and-fill and square-set will be the chief methods employed in under-

*Abstract of a paper presented at the Lake Superior meeting of the A. I. M. E., Aug. 23-28, 1920.

ground mining, with subordinate use of the incline cut-and-fill method where applicable. A system of shrinkage stoping with pillar caving will be used for a converter orebody in quartz porphyry.

Shrinkage stopes are used only in hard ground in massive sulphide areas. The shrinkage method shows a lower cost for timbering and waste filling than any other method used, and, in addition, permits the accumulation of a large reserve of broken ore.

The incline cut-and-fill method has been used on a few narrow orebodies, where one wall was too weak for the application of the shrinkage method and where there were no diorite dikes cutting through the orebody.

Steam-Shovel Mining

Most of the orebodies above the 500-ft. level are at present bulkheaded and inaccessible on account of mine fires. As the ground in this area was generally badly fractured, square-set methods were necessarily used. By the use of the plenum system of forcing air under pressure into the fire stopes, it was found possible to mine this ore, but only at an extremely high cost. The present plan, now under way, is to strip a total of 14,000,000 cu.yd. overburden and complete the mining of all the orebodies of the mine to the 500-ft. level by open-pit steam-shovel methods. It is estimated that approximately 5,000,000 tons of direct-smelting ore will be recovered to this depth. This is equivalent to one ton of ore recovered for each 2.8 cu.yd. of overburden removed.

Modern Commercial Explosives And Their Uses

By A. J. Strane, E. M.*
Tamaqua, Pa.

EXPLOSIVES may be classified as those that burn and those that detonate. Explosives of the first class include black, blasting, and smokeless powder, and are broadly known as low explosives, or propellants, because they merely burn and do that comparatively slowly. Their action is as if some power behind the projectile or other material were exerting a shoving, or pushing action. The high, or detonating explosives produce a smashing or shattering effect upon the material.

In using military explosives of the propellant class, the breach of the gun, or cannon, is proportioned to hold the pressure, so that the projectile will be blown out. Exactly the reverse is true in commercial work; then it is the "breach" or the hole that is to be broken. Therefore, the projectile and the explosive that will rupture the largest "breach" possible are chosen. With the high explosives, it is easy to break out the breach, but with some of the low explosives it is necessary to plug up the muzzle very carefully before shooting.

Doubtless the use of incendiary mixtures of oxidizing and combustible materials led, in the thirteenth century, to the perfection of the mixture which is practically the same as our commercial black blasting powder of today. About 600 years later, nitroglycerine was discovered, but for years its great potential energy could not be used, because, in its liquid state, it could not be safely handled or transported. The accidental discovery that kieselguhr would absorb, and hold fairly well, three times its own weight of nitroglycerine, however, made it available.

"Guhr dynamite," as the combination nitroglycerine and kieselguhr was termed, was soon displaced by dynamites having an active base, such as wood pulp and other carbonaceous combustible materials. These do all that kieselguhr will do, and, in addition, increase the chemical reaction and add materially to the effectiveness of the blast.

An accident is said to have led to the discovery that guncotton will cause the solidifying or gelatinization of nitroglycerine under certain conditions. This discovery gave us "blasting gelatine," which is taken as the standard for *100 per cent explosive*, as its composition is practically 92 parts nitroglycerine and 8 parts guncotton, with a small amount of antacid.

The commercial explosives of today are: Nitroglycerine; blasting gelatine; straight nitroglycerine dynamites of various strengths; straight nitroglycerine gelatines of various strengths; extra or ammonia dynamites and gelatines of various strengths; low-freezing explosives of the above grades; permissible explosives, or coal-mine powders, of various strengths and physical properties; miscellaneous explosives, having special advantages for special work; non-freezing or non-nitroglycerine explosives; and black blasting powder of various sizes.

*Abstract of a paper presented at Lake Superior meeting of the A. I. M. E., Aug. 23-28, 1920.

Hoisting Equipment at Utah Apex Mining Co.

By J. A. Norden and A. R. Willson*
Bingham Canyon, Utah

THE hoisting equipment of the Utah Apex Mining Co. is capable of handling about 1,200 tons per day. It has not been worked to capacity, but 600 to 700 tons, together with men and materials, have been handled in two shifts without great effort.

A Nordberg engine of the double-drum, geared type, designed for a 10-ton load, including rope, at a speed of 1,500 ft. per min., is used. The drums are 7 ft. in diameter, with a 54-in. face, and have a capacity of 3,000 ft. of 1⅛-in. rope. The hoist is operated by a 500-hp. 16-pole, round rotor, 450-r.p.m. motor, which drives through a single reduction of 129 to 19. Speed is regulated by the variable resistance of a rheostat of the liquid, weir-control type. A sodium-carbonate solution is used as a conductor.

The current supply is three-phase, 60-cycle, 44,000-volts, which is stepped down to 2,300 volts by a set of three 250-kva., outdoor-type transformers. From the transformers, the 2,300-v. lines are carried to a bus and switchboard in the hoist room. The average load for starting a loaded skip is about 300 amp. for a few seconds; afterward, the full-speed running current is 75 to 125 amp. The hoist is controlled by three levers on the operating platform.

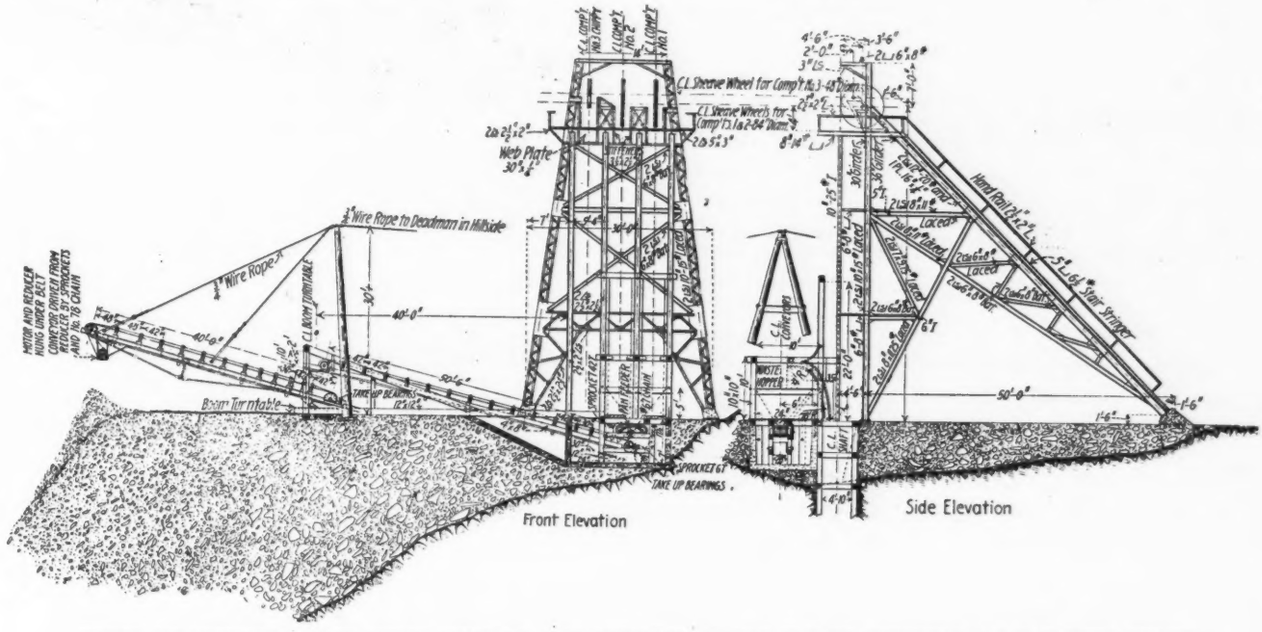
At the present time mining operations are in progress on the 100-, 1,150-, 1,300-, 1,500-, and 1,800-ft. levels. Three classes of material are produced on most of the levels: First-class or direct-smelting ore, second-class or milling ore, and waste. Hence, it was necessary to provide for handling at least two kinds of material simultaneously at the shaft. The 100-ft. level, being as adit, has its own waste dump, but some waste is hoisted to the surface from all of the other levels.

The ore pocket cut on the lower levels is divided into

*Abstract of a paper presented at Lake Superior meeting of the A. I. M. E., Aug. 23-28, 1920.

two parts by a reinforced-concrete wall. The ground is hard, requiring no timber, and a small pillar was left between the main storage pocket and the shaft. Below the storage pockets are measuring pockets which hold one skip load. The top of the storage pocket is covered by an 8-in. grizzly made of 30-lb. rail. On the 100-ft. level, owing to soft ground, it was necessary to build the entire pocket in direct connection with the shaft.

directly over the skip box, leaving only enough room for the latter to work freely. This arrangement would interfere with loading; therefore the floor was made in four sections, hinged so that it can be folded back when rock is being hoisted. The floor is of ⅜-in. plate and is supported by 4 x 4-in. angles, which are bolted to the bail and braces. When men are being hoisted or lowered, doors are used.



STEEL HEADFRAME, SKIP DUMP, HOPPER AND CONVEYORS FOR WASTE DISPOSAL AT PARVENU SHAFT

All ore is dumped at what is known as the 900-ft. level dumps. From here it goes through chutes to the large receiving pockets of the 100-ft. level. Reinforced concrete was used, as the ground would not stand without support.

A belt conveyor transports the waste from the hopper at the skip dump to the edge of the waste pile. Because of the steep slope of the hillside at the shaft collar, the waste dump is inclined to creep, especially during the spring thaw. Therefore, a continuous stationary conveyor would be impracticable, and two conveyors were used. The first, which takes its feed from a pan feeder under the skip-dump hopper, is of the stationary type and was extended as far from the shaft as was deemed safe, about 40 ft. The main members of the framework for this conveyor are anchored to the concrete walls of the pit, making it practically self-supporting. The second conveyor is of the swinging-boom type, and has steel framework, which is suspended from a bipod. The lower end is hinged on especially designed bearings on a turntable under the head pulley of the first conveyor. This construction not only makes the conveyors independent of the sliding dump, but, as the boom may swing in an arc of about 90 deg., the total capacity of the piling system is greatly increased. The conveyors are operated with 5-hp., 440-volt, 3-phase, 60-cycle, induction motors, rated at 1,700 r.p.m.

The headframe contains no particularly new features. It is a sturdy well-built affair, but is not high enough for present purposes. An additional 10 or 15 ft. clearance over the skip when it is in dumping position would be desirable.

The skip and cage are combined. On account of the low headframe, it is necessary to put the cage floor

The capacity of the skip box is about 70 cu.ft., or 4½ tons of ore. The total weight of the skip and cage is about 5,000 lb.

Standardizing at North Butte Mining Co.

BY ROBERT LINTON*

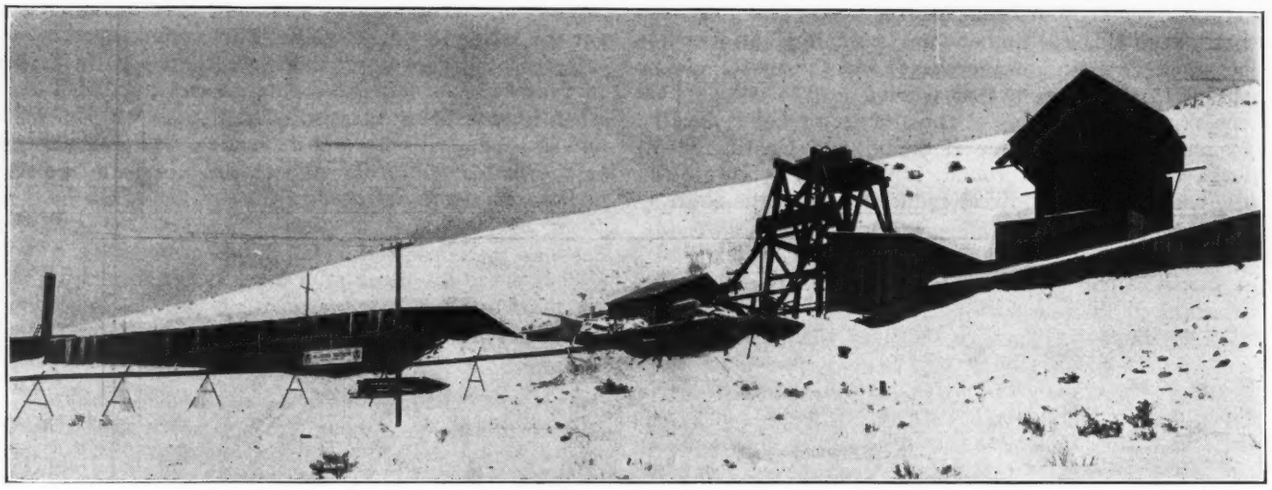
This paper deals with the work that has been carried on for over three years by the management and staff of the North Butte Mining Co. in an effort to standardize mining methods, to eliminate lost motion in the operating organization and to improve the efficiency of the individual workman.

Such items as the selection of machine drills and equipment, the proper type of drill, steel, ventilating equipment, ore handling, drill rounds and timbering were given special attention in order to ascertain the correct method of work and use of equipment. All sorts of experimental efforts were expended in the desire to determine the best method of performing any particular task. The studies developed some features which it is believed are new.

The paper is replete with tables and illustrations showing the basis of the results obtained and the application of the principle of standardization to some special problem. The human factor is given its share of importance, and time studies were made of drilling, timbering and other operations so as to form an intelligent basis for rating a day's work.

Regular instruction in promoting efficiency in underground work is carried on and shift bosses are trained "from the ranks."

*Abstract of a paper presented at the Lake Superior meeting of the A. I. M. E., Aug. 23-28, 1920.



HEADFRAME AT CONCRETE LINED SHAFT OF CHIEF CONSOLIDATED MINING CO.

Concreting the Chief Consolidated Shaft At Eureka, Utah

Work of Lining Carried on Simultaneously With Sinking and Was Done in Stages of 50 to 60 Ft., According to the Nature of the Ground—Average Advance, 61 Ft. Per Month—Precast Dividers Used

By R. D. Gardner
Foreman, Walter Fitch, Jr., Co.
Written for *Engineering and Mining Journal*

THE use of concrete in the construction of mine shafts has become more and more extensive during the last decade. The apparent permanency and safety from fire, together with the low upkeep, have done much to stimulate such shaft construction throughout the mining districts of the world.

At the Chief Consolidated mine in Eureka, Utah, 2,000 ft. of shaft was to be constructed through a soft monzonite porphyry, so the main problem was to use material and construction capable of holding the heavy swelling ground. The shaft has three compartments, 4 ft. 2 in., 4 ft. 2 in., and 6 ft. 1 in., respectively, in width. It was decided to concrete and carry the concreting and sinking along, as far as possible, at the same time.

Villadsen Brothers, engineers and contractors of Salt Lake City, worked out the concrete plans and specifications and did the precasting and mixing. The Walter Fitch, Jr., Co., shaft and tunnel contractors, performed the sinking and concrete construction.

Through the first 50 ft. the shaft sets were replaced by inside forms and a solid wall of concrete was poured. This was necessary because for that distance the porphyry was very loose and so affected by surface conditions that any other construction would hardly have sufficed to hold the ground. For the remaining distance a wall of reinforced concrete 8 in. thick was constructed. This wall was braced every 10 ft. by allowing the concrete to extend to the ground for a thickness of 5 ft. from the sides and ends. It was supported by a solid bearer, or support collar, constructed at intervals of 100 ft. The bearer consists of a heavily reinforced panel of concrete completely surrounding the shaft and running out for 5 ft. into special hitches cut in the country rock on each side of the shaft. It is designed to hold about three times the weight of the concrete resting on it; thus providing for any local disturbance of the country rock itself.

As sinking progressed, 6 by 6-in. wall plates, centers and end pieces, with 4 by 6-in. posts, were hung every 2½ ft. and blocked in the usual manner. These were tightly lagged and served as the outside forms for the concrete. The work was done in stages averaging from 50 to 60 ft., according to the nature of the ground and dependent entirely on the length of time the outside forms would hold the ground without being pushed out of alignment. As soon as stress was detected sinking was discontinued, inside forms were placed, and concreting was begun. Thirty-five feet was the shortest stage and 75 ft. the longest, although about 50 ft. was the usual distance.

Before concreting was begun the cross timbers from which hang the pump and bulkhead were lowered so as to rest upon the third set from the bottom. They were then below the lowest point concreted during that stage. As the weight of the first four or five pourings bears directly upon this point, it was necessary to brace and bulkhead it exceptionally well. The permanent dividers were then lowered to replace the 6 by 6-in. centers. They consist of precast concrete beams 2½ ft. high and 5½ ft. wide, of hollow web construction and designed to withstand a diagonal thrust as well as ordinary lateral pressure. They are heavily reinforced and so constructed as to make a bond with the wall of concrete over their entire height.

Near the collar of the shaft a concrete mixing tower was constructed, at the top of which were four bins large enough to hold sand and gravel for making 40

cu.yd. of concrete. Each bin was lined with steam pipes to prevent the material from freezing. The sand and gravel were hoisted to these bins by means of a bucket elevator. Measuring hoppers were placed directly under the bins, and from these the material was emptied into the mixer. Center-trip buckets, on trucks, transferred the concrete from the mixer to the shaft and were lowered through two compartments by separate hoists, discharging their contents directly into the forms.

I-beams and timber from the force of the blast, also served as a shelf on which a bulkhead of lagging could be placed. In this way any or all of the compartments could be bulkheaded tightly and thus afford excellent protection for the men below. The bulkhead was swung from cross timbers resting on the wall plates of the form sets by means of one-ton chain blocks over each end compartment. Before hanging a set the bulkhead was lowered by means of the chain blocks for the required distance and the timber let down upon it. The

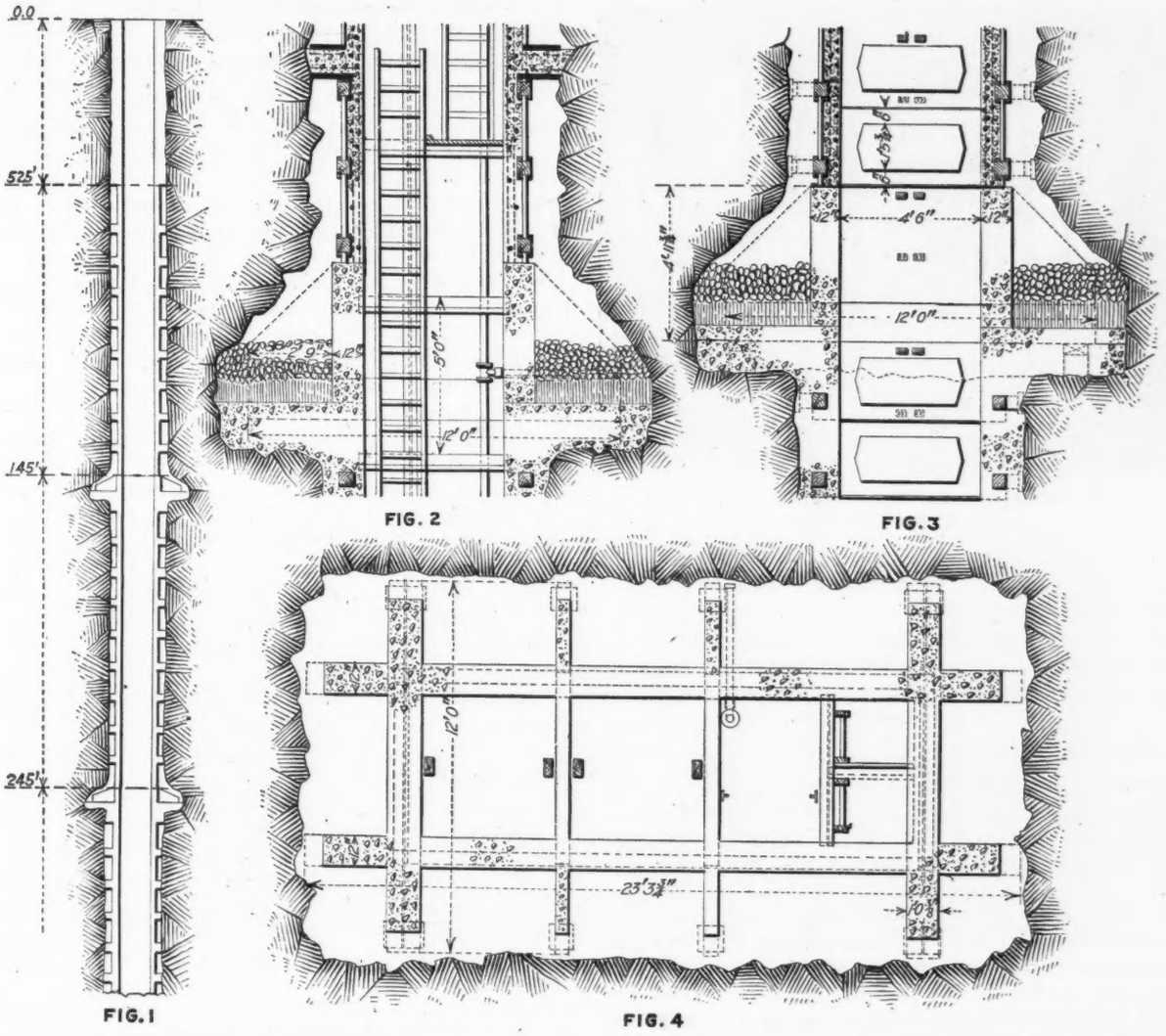


FIG. 1. FIG. 2. FIG. 3. FIG. 4.

FIG. 1. SKETCH SHOWING FIRST 245 FT. OF LINING OF CHIEF CONSOLIDATED SHAFT. FIG. 2. VERTICAL SECTION THROUGH END OF SUPPORT COLLAR. FIG. 3. VERTICAL SECTION THROUGH MIDDLE COMPARTMENT, SHOWING PRECAST DIVIDERS. FIG. 4. HORIZONTAL SECTION AT SUPPORT COLLAR

A steel bulkhead was used below the bottom set, which allowed the placing of the timber or outside forms without delaying the drilling or mucking. The bulkhead was made of 8-inch standard I-beams and measured 17 ft. 6 in. long by 6 ft. 2 in. wide. The main or side beams were tied together with cross beams, one on each end, and two cross beams or dividers, 4 ft. 7½ in. and 11 ft. 2 in. respectively, formed the south end. The cross beams were placed so as to come directly under the end-form timber and the false, or temporary, dividers of the form sets. Bolted on this frame were sheets of steel ⅜ in. thick and wide enough to cover the I-beams and overlap 10 in. on the inside of the beam. This overlapping, besides protecting the timbermen working on top of the bulkhead then proceeded to install the set.

The work of sinking was made somewhat difficult by a flow of water of from 60 to 150 gal. per min. This water was raised from the bottom to a pump station by means of an air-driven sinker. On the pump station was installed an electrically driven plunger pump, which lifted the water to the station above. These stations were constructed at intervals of 300 ft., the maximum lift of the sinker. The crew consisted of four or five shaftmen and a shift boss, in the bottom; a pumpman, topman, and two hoistmen on each shift.

The best progress was made by drilling one-half of the shaft at a time. In this way mucking continued

up to the time the round was finished. A round of fourteen holes was sufficient to break half of the shaft for a depth of 5 ft., or an average of two rounds a day made a 5-ft. advance. The holes varied in depth from 7-ft. cut holes to 5½-ft. end holes. Forty to fifty pounds of 50 per cent gelatin powder was used to break the round. Ordinary water proof fuse, well crimped into a cap and dipped in P. & B. paint, gave good service, and little trouble was experienced with missed holes. When the shaft passed the 1,100-ft. mark, however, it was considered safer to use delayed action exploders.

LOOKING DOWN CONCRETE LINED SHAFT AT CHIEF CONSOLIDATED MINE

An average advance per month of 61 ft. of finished shaft, including pump stations, was maintained. Actual sinking operations consumed 70 per cent of the total time, and concrete construction 30 per cent.

The Future of the Swedish Iron Industry

Sweden is compelled to import large quantities of iron products, although possessing immense iron deposits, according to *Commerce Reports*, and this is owing to the fact that Sweden has practically no coal mines, and being unable to obtain coal from Germany, prices on this article are so high as to be almost prohibitive. It is well known that many finished articles imported into Sweden are made from Swedish steel.

Another factor is the chemical quality of the ore, which in many instances requires mixing with imported ores to produce desired properties in the steel.

In this connection it is of interest to refer to an article by a well-known Swedish mining engineer regarding the future of the Swedish iron industry:

> The answer to the question why the iron industry seeks the coal industry is simply this: It is cheaper to transport the ore to the coal than vice versa. A simple calculation will tell us that for each ton of finished iron is required about 2 tons of coal and 1.6 tons of ore (for rich ore). These relations are not, however, permanent. About thirty and forty years ago it was 3 and 4 tons, and it is not impossible that in a not very distant future the relations may be 2 tons of ore to 1.5 tons of coal per ton of finished iron.
>
> Then the conditions shall have moved in favor of the countries rich in ore. In the beginning of 1870 Sweden was compelled to turn over its quantitative superiority on the iron market to countries richer in coal. Regarding the quality production of the malleable iron, however, our iron industry retained its place. Our good raw material and inherited trade skill enabled us to back up our position.
>
> That we have succeeded in holding our place so far has its root in the ever-increasing demand for quality products and our endeavoring to meet the new requirements through technical improvements. The burning question for Sweden's iron industry will be whether or not electro-steel will, in greater degree than other cast iron, be able to replace the Swedish quality iron and place a weapon in the hands of our foreign competitors to reduce the importance of the quality inherited from our charcoal pig iron.
>
> Another technical factor is the production of excellent steel by adding metals such as nickel, chrome, and other hardening and toughening elements to foreign raw material, thus becoming independent of Swedish iron.

Italy's Sulphur Production

The war has imposed a serious check on the development of the Italian sulphur industry, according to Attaché Alfred Dennis. Italian production has been cut from 330,000 tons in 1914 to 180,000 tons in 1919. The reasons adduced for this decline are lack of labor and the difficulty of keeping up the mechanical equipment of the mines.

The cost of production has increased tremendously. Before the war, sulphur was mined at from 80 to 85 lire per ton (all sulphur figures are given in short tons). Since the last advance in wages (May, 1920), production costs are estimated at from 420 to 430 lire per ton. Pre-war prices f. o. b. Sicilian ports ranged from 110 to 115 lire per ton; the last price advance (May 1) brought the quotation up to 650 lire.

Whereas in former times Italian sulphur found a wide market throughout the European countries, its sale is now practically limited to the Mediterranean Basin, the consuming countries being identical with the wine-producing regions of southern Europe. Sulphur is an indispensable adjunct to the cultivation of the vine as an antidote for the mildew which attacks the flower of the grape. Sulphate of copper is also employed to spray the vines as a protection against parasites. On account of the scarcity and high prices of fuel in Sicily, a wasteful process for the recovery of sulphur has to be employed.

It is not strictly correct to imply that Italy's sources of sulphur supply are limited to the Island of Sicily. There is a district on the Adriatic near the cities of Rimini and Pesaro where sulphur is mined. One small mine is in operation on the east coast of southern Calabria. The amount of sulphur produced on the mainland, however, amounts to only about 10 per cent of the total for all Italy.

Chinese Antimony

Since 1908 over 50 per cent of the world's total antimony production has come from China. In 1913 the output was estimated to be the equivalent of 10,800 tons of metallic antimony, that of the whole world being about 20,000 tons.

The Wah Chang Mining & Smelting Co. virtually controls the production of antimony ore, regulus, and crude in the Province of Hunan. This company operates smelters in Changsha and owns low-grade mines. It possesses a complete monopoly, granted by the Peking government, for the manufacture of regulus in Hunan, and owns the patent rights in China for the Herrenschmidt furnace, the most successful means of reducing low-grade antimony ores. The mines themselves are mostly native owned, and worked in a small way.*

*H. G. Ferguson and D. A. Hall in "Political and Commercial Geology," McGraw-Hill Book Co., 1920.

Through Villa Territory

A Mining Engineer Journeys From Juarez to Santa Barbara, Chihuahua, Before the Bandit's Surrender—No Casualties Reported en Route but Many Inconveniences—Rags, Ruins, and Native Fear of Bandits Chief Features of Trip

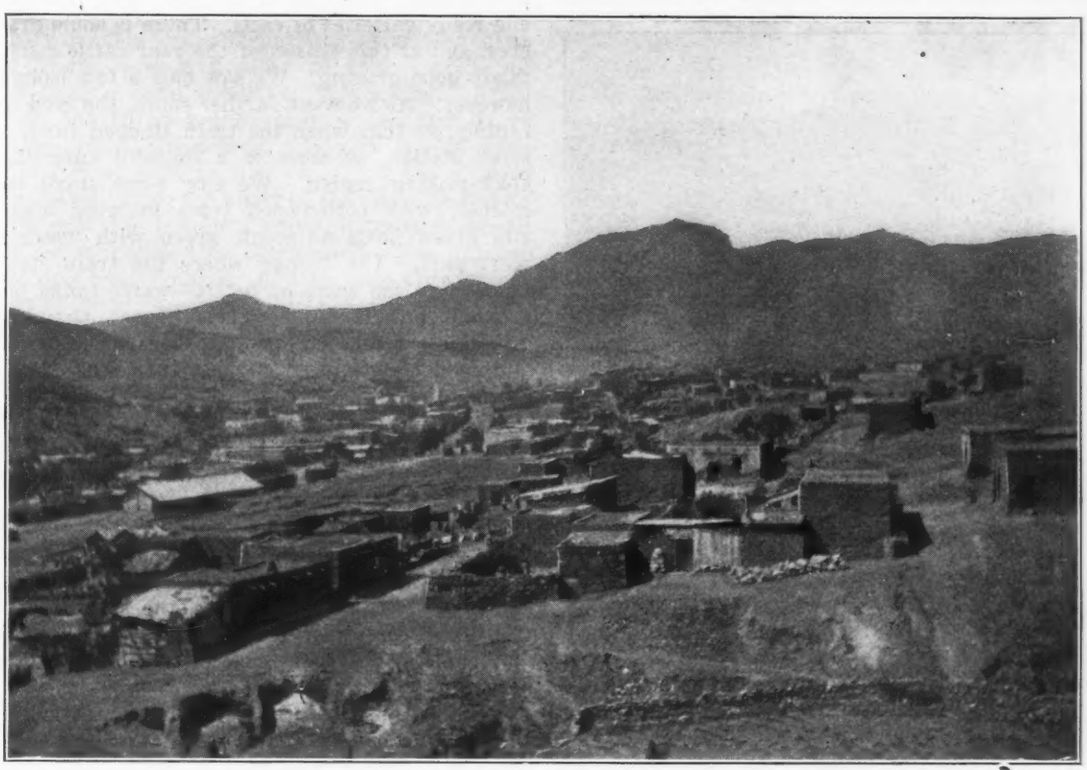
Written for *Engineering and Mining Journal*•

BEFORE one can cross the border today between Mexico and the United States a passport must be obtained. This necessitates some special photos—*specially* bad, that is, since the State Department is not interested in our good looks, but wants them natural, unretouched, of ourselves alone.

With these in hand, then, we went to the United States Immigration Office at the International Bridge between El Paso and Juarez, where a special border permit was issued and one of our artistic photos mounted on it. A duplicate is kept in the office. With this border permit we proceeded to the Mexican consul in El Paso, who viséd it, charged $2.50, and filed a couple more of our photos. We then took a taxi and crossed the bridge into Juarez and called on U. S. Consul Dow, who also viséd our passport and wrote thereon a special permit for one trip to Santa Barbara.

Next we went to the Mexican Customs, where an official of the latest government affixed a revenue stamp —50 *centavos*. We now had an emergency passport, good for one trip to our destination, but had to have a regular passport if we intended to stay in the country. Hence we proceeded to the clerk of the Federal Court in El Paso and made application, fee $2, which had to be accompanied by birth certificate, and photos, and affidavit of some person knowing the applicant two years or more. This was forwarded to Washington and in due time a permanent or six-months passport may be expected.

We then set out to our destination, which we were to reach, God and Villa willing. Hold on! I overlooked a few yards of tape. After crossing the bridge into Mexico and calling on Consul Dow, one cannot re-enter the United States without passing inspection for vaccination. If he can show a recent scar, or lie strongly enough about the one he has, he may get by. Otherwise, he gets a shot in the arm. I lied ten years about mine, but did not go strongly enough, so the doctor gave me the shot.



SANTA BARBARA, CHIHUAHUA, A TYPICAL MEXICAN 'DOBE TOWN

Of course, there is the regular customs inspection of both governments. The United States inspectors search outgoing passengers for firearms, which are not permitted to be taken across the border. The Mexican customs look for dutiable goods and other things.

We went to Juarez the evening before our train left, so as to get used to the local color, which is here laid on with a bold brush. Juarez is a typical 'dobe town of the northern Mexican states. The buildings along the principal streets present a solid 'dobe front, one-story high, flat topped and broken with doors and windows, the latter, however, not very numerous. Light can be had without building houses to let it in. Some of the better houses have courtyards after the Spanish style,

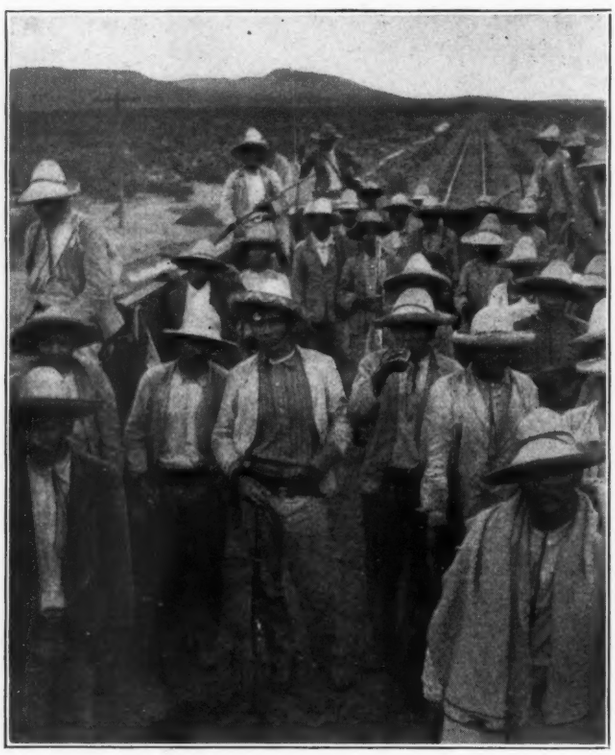
•Written before Villa's surrender.

and even some of the poorest and most squalid tenements open on a common court. There are a number of more imposing buildings housing government offices, including the Custom House and a school. Then there is the Bull Ring, and a couple of brick- or stone-front business blocks.

The population appears to be made up of very poor Mexicans, Chinamen, American sightseers, American saloon-keepers, gamblers, and all sorts of border riff-raff; a sprinkling of people who, like myself, were going somewhere, and the better Mexican class, officials and business men, who fill in the background.

Two Hundred Ragged Guards per Train

Our train left Juarez at 7 a.m. There were a dozen freight cars, a second-class coach, one first-class coach (in name only), and two steel "gondola" cars, one ahead of the coaches and one behind. In these steel



TRAIN GUARDS IN STEEL "GONDOLA" CAR

cars rode our guard, federal soldiers who guard every train. There were about two hundred men on this train. Every one has read of the barefoot army and the tatterdemalion soldiers of Mexico. I want to say to your imagination, Go as far as you can. Imagine everything grotesque, unkept, undisciplined, underfed, and unfit. You can hardly match the truth. I did not see a pair of shoes in the outfit except those worn by officers. Some wore a rough sandal, home made, of old leather or whatever came to hand; worn-out auto tires, belting, rubber, or fabric of any kind. Some were bare of foot except for the coating freely supplied by Mother Earth. Ragged breeches or overalls, and shirts in various stages of fragmentation, generally constituted the sole clothing. All wore the grotesque, large straw hats of Mexico, in every degree of decrepitude. Some had a ragged dirty blanket or *serape* thrown loosely over the shoulder or worn like a shawl.

Their weapons were as grotesque as their clothing, a varied assortment of rifles, Winchesters, Springfields, Spanish Mausers, German Mausers, and others, all looking as though they had been taken from a museum. A tin canteen, a small coarse provision bag, and one or two cartridge belts completed the accoutrement.

Our train had hardly got away from the station when we began to see evidence of the battles that have taken place during the many revolutions and counter revolutions that have torn Mexico during the last ten years. There were 'dobe houses shot full of bullet holes, or blown up; small circular forts of 'dobe three to five feet high; barbed wire entanglements; trenches and holes in the desert large enough for only one man. We passed the cemetery where victims of battle are buried like rats in trenches.

South of the border, for forty or fifty miles, the country is mostly uninhabited desert, sparsely strewn with grease wood, mesquite, and other desert shrubs, and many varieties of cacti. There is some grass, however, and at this season of the year cattle can still find fairly good grazing. We saw only a few isolated head, however. As we went further south, the land improved rapidly, so that when the train stopped for lunch at a small station, we were in a splendid agricultural and stock-raising region. We saw some small irrigation ditches, with cottonwood trees growing along them, and green fields adjacent, green with weeds for the most part. The village where the train stopped for lunch bore the scars of battle—water tanks blown up, a small circular 'dobe fort, houses abandoned and crumbling, a recently made graveyard beside the track, and dead horses rotting where they fell.

Mexican Troops Sans Commissary

A swarm of natives met the train with baskets of food to sell to the soldiers and passengers. These vendors do a lively business, as there does not appear to be any commissary in the Mexican army, and the train guards are obliged to feed themselves by buying stuff from the natives along the line. The offering consisted of *tortillas* and *frijoles*, the two great national dishes of the poorer Mexicans. There were also *enchiladas*, pancake-like cheeses, bread, cakes, fruit, and bottles of milk.

The first-class passengers went to a Chinese restaurant (the Chinaman is the national caterer in Mexico), and had a dinner consisting of much the same dishes; *enchiladas*, *frijoles*, stuffed peppers and rice with chili sauce. There was pie, but let that pass. The business of supplying food to the passing troops seems to be the only occupation of the handful of wretched people living in these shattered 'dobe villages.

During the afternoon, the train was running continuously through fat, green land, hundreds of thousands of acres, where formerly great herds of cattle grazed but which now lie deserted. It is said that the cattle were raided and run across the border into Texas, where they were sold to American stockmen or to the market, such as were not consumed by the raiders themselves. Villa and his followers have the credit for the job.

We passed over about forty miles of track, which had been rebuilt after having been destroyed with explosives. The old rails lay alongside of the track, warped and twisted into useless shapes. Everywhere bridges had been burned or dynamited, and rebuilt. Late in the afternoon we saw the *hacienda* where the Terrazas family, renowned for their wealth, formerly lived. This

family owned all the valley from the border to Chihuahua City and ranged great herds of cattle. It is said that they branded three hundred thousand calves yearly, and their herds totaled over a million head. Now all is deserted save for a few ragged peons living in crumbling 'dobes along the railway.

Stopovers Allowed on All Tickets

Our train arrived at Chihuahua City at 7 o'clock in the evening, and as the trains do not run at night, we unloaded ourselves and baggage, and had a bus convey us to the Hotel Palacio, a fine, large building in the Spanish style, three stories high, with big rooms opening on a court.

Beside myself there were two other guests, Americans, whom I had met on the train, and who were connected with the same company as myself, but going to different destinations. We were the sole occupants of a hostelry capable of accommodating several hundred persons. There were a number of other hotels, all seemingly in the same condition of vacancy. After dinner, we, the three guests, took a car and drove around the city. Stone-front business blocks gave evidence of former activity, but we did not see a single American. Away from the heart of the city, the streets were lined with the common 'dobes, outside of which the peons sat or reclined on the ground. The number of ragged and nearly naked children was astonishing, but evidently in harmony with biological law.

After covering the town, our driver, who had been instructed to show us everything, stopping in a particularly narrow and ill-appearing street, informed us that this was *"La Calle de Muchachas."* We all thought that there was no particular fascination for us in *"La Calle de Muchachas"* and told the driver to *"vamos."* We remarked the extraordinary number of plazas in the city, and some one found the explanation in the fact that the Mexicans were a plaza-loving people.

In the morning, while waiting for breakfast, I walked across the plaza and looked into the cathedral. Mass was being said, and many women were on their knees in devout attitudes. But the music—what was it that the organist was playing? Ah! I have it—the *"Barcarolle"* from the "Tales of Hoffman." I could not draw my face into as solemn an aspect as the occasion demanded, as I passed out and slipped a coin into the palm of a beggar at the church door.

As we drove to the station in the early morning to resume our journey, we saw more activity than one would think possible, judging from the inertia of the evening before. Donkeys laden with milk cans, and the milk man were coming to market. Other donkeys with fruit and vegetables made up a colorful caravan. Along the streets, the sidewalk merchants had spread their wares; bottles of milk, *tortillas* patted out in the hand and cooked on a piece of sheet iron or tin over a few coals in the street, while you wait; *frijoles, enchiladas,* coffee, cakes, and fruit—a variety of stuff to alleviate hunger, but hardly appealing to an appetite cultivated above the Rio Grande.

Better Halves (?) Have Makeshift Quarters

The scene at the railway station was colorful and fascinating. There were several troop trains in the yards, and the guards on our train and the one going in the opposite direction added to the flux of life. The regular troop trains carried swarms of camp followers, degenerate females—one hesitates to call them more—who served the men. They had numerous children, naked little savages, and carried their household goods, reduced to the primitive minimum, with them. These women camp followers lived in box cars, cattle cars, flat cars, underneath, on top, anywhere—while the decrepit train was in motion. While in the yards on sidings, they lived underneath, on the ground. They prepared the *tortillas* and *frijoles* for the soldiers, thus serving as a commissary. Squalid, filthy, ragged, diseased, they gave the lie to Fiske's "Ascent of Man."

Peddlers and street merchants were hawking their wares, a babel of voices constantly chattering; engine bells were ringing, donkeys braying and strident bugles blowing. In response to a bugle blown by a Yaqui boy, bare-footed, ragged, and rifled, of the color of oxidized copper, a squad of the most villainous looking men, Yaqui Indians, drew up for inspection—a screaming farce—and then mounted a box car for special guard duty.

It appeared that the reason for the Yaqui guards lay in the fact that an officer rode in our car with a large amount of metallic money which was destined to pay the soldiers at the stations south of Chihuahua, where thousands of federal troops were moving north in an attempt to put an end to the depredations of Villa. These Yaquis are said to be the best fighters in Mexico. They do not know what fear is, while the soldiers of the regular—or irregular—armies are inclined to the policy of "Safety First." Yaqui soldiers have been known to turn and shoot their fleeing comrades.

Air Hose and Grease Classed With Jewels

Our train finally got away from the hubbub of the station about half an hour behind schedule. We were delayed somewhat while waiting for the brakeman to bring the connecting air hose from the safe in the depot and attach it to the coaches. Then he went back and got a can of grease-soaked waste, to fill the stuffing boxes on the wheel axles. The humor of these proceedings can hardly be appreciated without seeing them.

The day's run through idle grazing lands in the valley of the Rio Conchos brought us to the town of Jimenez. We passed through only one town on the way to Santa Rosalie. Here the station was filled with troop trains and our aforesaid paymaster detrained with his precious bags. The scene of the morning at Chihuahua was re-enacted here, with the added objectionable features of more filth and stench, and myriads of flies.

Along a cliff under the edge of the town we saw a number of caves inhabited by modern troglodytes. At Jimenez we encountered more troop trains. There were thousands of soldiers here. The railroad yards and streets were filled with them and the ubiquitous *mujeres* patting out their *tortillas* beside a few embers. As our train was to camp again for the night, we had *cargadores* carry our baggage to a hotel, where our company maintained a number of rooms for the convenience of its men traveling back and forth.

This hotel was owned and operated by one Doña Luisa, a woman having something of American pluck and initiative. Doña Luisa had come down here with her husband during the Civil War, to buy hay for Confederate horses. In the meantime, the Confederacy surrendered and Doña Luisa and her husband, not approving of the proceeding, refused to go back. Her husband has since gone further West. Doña Luisa is over eighty, but still manages her hotel. She is said to be the only one in the place who does not fear Villa,

and to have run off a bunch of his bandits with two revolvers, when they tried to raid her stock of liquors. Salud! Doña Luisa.

One other member of the party and myself were to leave the main line here and proceed on a branch line via Parral to Santa Barbara, a mining camp in the Sierras. It was at Parral that Villa was last heard from, when he made an attack on the town in the morning hours of June 2. Our train had the usual guards and also acted as escort for an unmixed freight train behind. If our train got out of sight or around a bend from the freight, it stopped while the latter caught up, and several times we were forced to stop for engine repairs.

Train Does a Serpentine

Near Parral, a railroad bridge across a small stream had been burned by Villa in his recent attack. A temporary track had been laid on the river bar, crossing the channel on an improvised trestle. Looking out of the coach, I saw the cars ahead dropping down a tremendous grade, 20 or 25 per cent. It was a perilous-looking performance, but the train stayed on the rails, crossed the stream and climbed the opposite bank, warping itself to the contour of the earth like a thick-bodied, giant snake.

Just at noon our protesting train came to a stop at Parral. We saw evidence of the recent fight, in breastworks of boulders on the outskirts of the town, and bullet-marked walls, and some recently-erected crosses. The water tank lay a twisted mass of ruins from earlier raids.

The town of Parral had been a prosperous and busy mining camp before the era of revolutions, but continued depredations of bandits have so harrowed the American companies operating there that these have, for the most part, ceased operations. Only one company, and that because of its superior financial strength, diplomacy, and political power, operates in the district today.

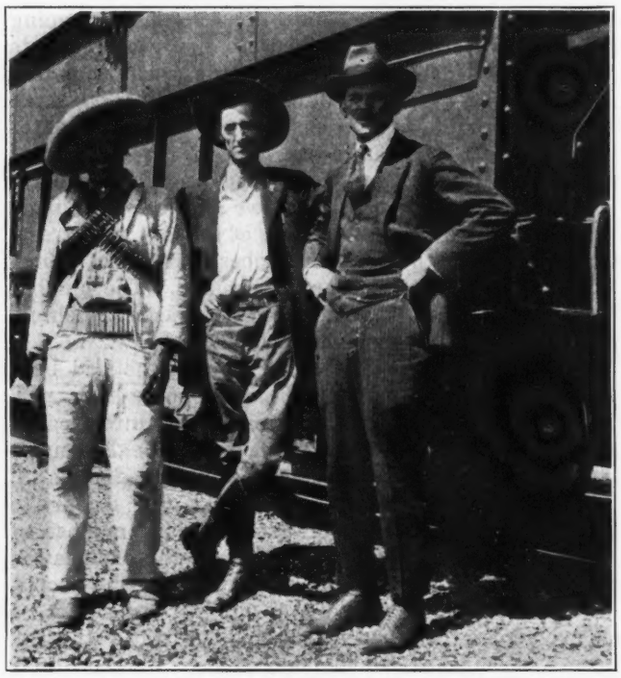
After an interminable wait, our train resumed its meandering way toward Santa Barbara, eighteen miles up the valley. Toward evening, it came to a stop in a terrific thunder storm, a mile short of the station, due to an engine derailed ahead. Fortunately, however, we were opposite the mine which was my destination, and a messenger came to meet us with a couple of *mozos*, who carried our baggage to the quarters assigned us in the American Club. Here at dinner we learned that, before attacking Parral, Villa's men had paid their respects to Santa Barbara, looting the principal store in the town and generously giving the mining company a receipt for all of its horses.

Abandoned Mines a Refuge

It is said that the town people were very inconspicuous during the stay of the Villistas in Santa Barbara, many taking to the hills and abandoned mines during the night. One official incumbent is known to have availed himself of the hospitality of some of the company employees and lain hidden in a closet for a night and a day. Previous to the visit, some of the natives employed by the company had twitted the Americans about Villa. "Just wait until Villa comes! You *gringos* will be very scarce." As a matter of fact, when Villa did come, these same individuals lay hidden in an abandoned mine, while the Americans entertained the Villistas at dinner.

But perhaps the greatest fear of Villa was in the hearts of the Chinamen. Mindful of the treatment accorded their countrymen in previous raids, they hid until it became apparent that there was to be no hanging or shooting. The peaceable behavior of the Villistas was, in all likelihood, owing to the fact that they met no opposition. Had they been shot at, they would have made reprisals by organizing a necktie party, or a firing squad; the former probably, as they were short of bullets and in such emergency are wont to resort to the rope.

After being beaten off in his attack on Parral, where he lost ten men, Villa headed in an easterly direction and was last heard of at La Reforma, on the main line, where he burned a small bridge and continued easterly,



SOLDIERS THREE

supposedly to meet a pack train from Eagle Pass, which was carrying ammunition that had been smuggled across the border.

The movement of troops into the district continues, until now there are reported to be over twenty thousand federals hunting for Villistas along the main line from Juarez to Jimenez.

Before Villa Surrendered

The present administration is evidently making a strong effort to bring Villa's career of outlawry to a close. But the federals are handicapped in hunting Villa on his own ground. Better men than Mexican soldiers fell down on the job once. And, too, Villa is better equipped than the federals, with the exception of ammunition, which defect may have been remedied ere now. His men are mounted, and exceedingly mobile. They are fearless fighters under a renowned guerilla leader. The only advantage the federals possess lies in superiority of numbers and control of lines of communication and transportation. The latter Villa may nullify at any time. On the outcome of the hunt for the outlaw, it is believed, rests the immediate fate of Mexico.

Dominant Features Controlling Ore Deposits Of Washington

Formations Genetically Related to Batholithic Intrusions of Granitic Rocks—Associated With Dikes in Stevens and Northern Pend Oreille Counties—Near Marginal Contacts At Some Other Points—Ores of Republic District Excepted

BY ERNEST N. PATTY*
Washington Geological Survey
Written for *Engineering and Mining Journal*

UPON examining the various mining districts of the State of Washington, dominant characteristics of the deposits are noted that continue to develop as field evidence is accumulated. Thus, a generalized perspective is permitted which simplifies the solution of the problems of the individual mines.

First in importance is the fact that practically all the deposits show evidence of direct association with batholithic intrusions of granitic rocks. These batholiths form the parent source of practically the entire metal resources of the state. The ore deposits occur in the northern tier of counties bordering the international boundary. This entire section, from the Selkirk range along the Idaho boundary westward across the state to the Cascades, is underlain by a series of batholithic intrusions apparently closely related. These continue northward into British Columbia and eastward into Idaho, where they are found genetically related to the ore deposits of important mining districts. Granodiorite forms the core of the Blue Mountains of northeastern Oregon, and the striking similarity of field evidence observed both in northeastern Oregon and Washington suggests that the two batholiths may be directly related. The intrusions of northeastern Washington have been provisionally assigned to the Mesozoic.[1]

I shall not here attempt to correlate the mining districts of Washington with those of the surrounding, and often better known, districts in the adjoining states and in British Columbia. It is believed, however, that the Washington deposits are a link in the chain of an extensive metalliferous area which will later submit to a broader correlation based on accumulated field observations. I have not yet undertaken field work in the Cascade Range of western Washington and the generalizations of this report do not include that section. The gold veins of the quite well-known Republic district in Ferry County represent a distinct period of mineralization younger than the surrounding districts and they are not considered in this article.

CAMP OF ELECTRIC POINT MINE, TWENTY MILES EAST OF NORTHPORT, WASH., AT AN EARLIER STAGE OF OPERATION. TOPOGRAPHY SHOWN IS TYPICAL OF THAT OF SURROUNDING COUNTRY

TOPOGRAPHY OF NORTHERN WASHINGTON DISTINCTIVE

In northern Washington, from the Idaho line westward to the Cascade Range, the topography uniformly consists of a series of mountain ranges trending north and south, the forested ranges being separated by broad

*Published by permission of Henry Landes, State Geologist of Washington.

[1]Weaver, C. E.: "The Mineral Resources of Stevens County, Wash." Geological Survey, Bulletin 20.

glacial trenches. The floors of these trenches, often one to two miles across, are occupied by streams so small as to be totally out of proportion to the giant troughs. These valleys are at elevations of 1,500 to 2,000 ft. above the sea, and the average elevations of the associated ranges vary between 4,000 and 5,000 ft., with ridges occasionally culminating in peaks attaining maximum elevations of 7,000 ft. This characteristic topography is noted on entering the state from British Columbia and continues southward approximately 100 miles to a latitude a few miles north of Spokane, where the ranges rapidly lose their prominence and disappear beneath the northern extension of the Columbia River basalt plateau.

Dikes Associated with Orebodies in Northeast

Northern Pend Oreille County, in the northeastern corner of the state, and Stevens County, adjoining on the west, are covered with an extensive series of metamorphosed Paleozoic sediments tilted to a steep angle and overlying, for the most part, the intrusive granitic rocks. The ore deposits here occur as irregular replacement bodies in the metamorphosed series. With more extensive development, some of the larger deposits may be found to extend down into the underlying granites. Closely associated with all these deposits are found igneous dikes which mostly approach lamprophyres and granite porphyries in character. In some cases, the ore is found in contact with these dikes, but more often the dike is 10 to 150 ft. from the ore. This association has led to a confusion of ideas and in some cases resulted in exploration work being improperly directed. I believe these dikes, as a general rule, to be feeders from the underlying batholith which forced their way up through the overlying sediments.

The dikes naturally sought out the shattered zones for their entrance into the metamorphosed sedimentary beds; the intrusive force of the dikes further shattered the brittle sediments. The total result was that the shattered ground adjacent to the dikes offered inviting conduits for the mineralized hydrothermal solutions and the gases, which were exhaled from the magma a little later than the dikes. In the United Silver-Copper mine concrete evidence is offered to prove that the dikes are earlier than the ore, for on the 1,200-ft. level a considerable portion of the vein is found filling a shrinkage crack in the dike.

Invaded Formations Have Influenced Ore Deposition

The shape and often the extent and richness of the ore deposits were effected by the character of the formation into which the mineralized solutions were injected. The highly folded and tilted position of the sediments often placed them in a favorable position to receive the mineralized solutions and gases through fractures opened along the bedding and schistosity planes of the formations. The zones of weakness in such formations would naturally be along these planes. However, should the beds be so favorably oriented that the components of shattering forces were applied at certain angles to the planes, then the fractures would tend to cut the formations at angles to the bedding or schistosity planes. These two types of deposits are common to argillites and schistose rocks in Stevens County and are well represented by the Loon Lake deposit, the United Silver-Copper, and by smaller deposits such as the Frisco-Standard and the Bonanza.

Brittle formations, when ruptured, often develop irregular undulating fractures. If such a fissure should later be subjected to faulting along the plane of fracture, some of the walls would be brought into such juxtaposition that pinches and swells would be developed. These conditions are strikingly represented by the Reardon Copper deposit and, to a lesser degree, in the United Silver-Copper vein.

Planes of contact between two formations, such as argillite and quartzite, are in some cases planes of rupture. The quartzite is not as favorable for ore deposition as the argillite, as the argillite yields more readily to metasomatic replacement than does the refractory quartzite; and, further, the organic matter in the argillite has acted as a precipitating agent on ore-bearing solutions.

Limestone, under favorable conditions, is readily susceptible to replacement by mineral-laden solutions and gases. A belt of limestone that has been stressed by folding and then intruded by igneous dikes will ordinarily develop irregular fracture patterns which ore solutions may later use as a conduit. The intersection

KAABA VEIN ON 200-FT. LEVEL OF KAABA MINE, WASHINGTON. TRUE WIDTH NOT SHOWN ON ACCOUNT OF RIB OF WASTE ON FOOT-WALL SIDE

of two or more fractures affords an inviting locus about which heated solutions may work to replace the limestone and deposit ore in irregular pots and chimneys. The Electric Point deposit and the deposits in the Metaline district of Pend Oreille County are striking examples of this phenomenon.

Deposits Occur in Igneous Rocks

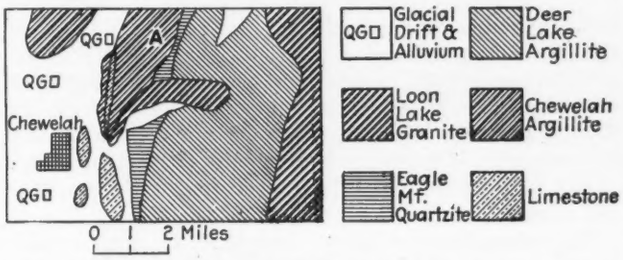
In southern Pend Oreille County and westward in Ferry and Okanogan counties, the metamorphosed roof rocks are less conspicuous, and large areas of granitic rocks, varying in composition from true granite to diorite, are exposed. Here the ore deposits are more often found inclosed in the granitic rocks. It is particularly pertinent, however, that some of the most promising deposits occur near the marginal contact of the granitic rocks and the older intruded formations as marginal veins. In the Newport, Nespelem, Concunully, and Oroville-Nighthawk districts and near Danville there are veins near the roof of the batholith adjacent to its contact with the older intruded rocks. Near the Nespelem deposits the roof rocks have been completely removed by erosion, but, judging from the surrounding horizons, the present granite outcroppings on Mineral Hill repre-

sent the upper limits of the batholith near this particular locality.

As the laws governing the formation of veins and other types of metalliferous deposits are better understood, it seems safe to predict, the occurrence of ore deposits near the margins of the intrusive rocks will be more readily appreciated. It is logical that, following the invasion of a batholitic mass, the margins of the magma in contact with the older rocks would be the first to crystallize. Crustal tensions developed by shrinkage and recurrent heavings originating deeper in the partially cooled magma would develop fissures in the granitic rocks and even across the contact into the intruded formations. Such fissures would offer excellent conduits for mineralized solutions and gases which might be exhaled by the cooling interior of the magma.

Localizing Influences Discussed

If the protective roof rocks overlying a batholith could be suddenly stripped off, the underlying granites would probably be found not with flat relief, but with an uneven undulating surface and with cupolas or domelike projections above the general level, this irregular relief originating from a series of complex conditions



AREAL GEOLOGY OF CHEWELAH DISTRICT, WASHINGTON, SHOWING OCCURRENCE OF PRINCIPAL ORE DEPOSITS AROUND A GRANITE STOCK

which caused the distribution of the intrusive forces unequally over the marginal surfaces of the mass. The idea is not new; the phenomenon has been recognized and described by numerous observers. These so-called cupolas are admirably exposed in Stevens County, where erosion has stripped off part of the old roof rocks and bared small sections of the underlying batholith. An excellent example is the Chewelah district, where the ore deposits occur principally in the argillites, but around the periphery of a granite stock or cupola.

When plunging contacts, rather than those approaching the horizontal, appear, pendants or blocks of the old roof rocks are suspended down into a batholith 2,000 feet or more, and often of such horizontal extent as to measure two or three miles in diameter, all boundaries of the pendant except the upper being surrounded by the intrusive rocks. In northern Okanogan County one of these pendants was observed to be continuously connected with the roof rocks of the area, which proves that it is not a detached block immersed in the batholith but a roof pendant projecting downward into the mass, and which represents a lower portion of the roof rocks. This phenomenon of roof pendants as occurring in the Okanogan Highlands was first interpreted by Daly.[1]

Along the marginal contact of such a pendant it would seem that favorable conditions could exist for the development of fissures which might later become channels for mineralized hydrothermal solutions and gases. Complementary to the pendant there could ordinarily exist the margin of a granitic stock. The function of the stock or cupola would be to collect and concentrate the ore-bearing solutions and gases from the remainder of the batholith. The function of the pendant would be to encourage the development of fissures by chilling the margins of the batholith. I advance this hypothesis as a possible influencing factor on certain Western ore deposits.

The mechanics of fissure development is none too well understood, and there is generally a tendency to pass it by with a vague sentence or two about regional compressive or tensional strains. There is little doubt that these offer the best fitting explanation for many districts, but I feel that, at least in certain districts, the factors governing the development of fissures can be traced to local causes. Particularly in the Oroville-Nighthawk district of Washington there are found several large marginal veins which satisfactorily bear out this conclusion. In fact, it was while I was engaged in field work in this area that this theory first suggested itself.

At the Kaaba and Four Metals mines field evidence favors such conclusions. Large quartz veins occur at the margin of the quartz batholith. The contact between a roof pendant and the granite stands nearly vertical. The veins trend across the contact and into the pendant a distance of several hundred feet, then gradually "tail" out. They gain their maximum width (up to 15 ft.) on the granite side of the contact several hundred feet from the margin. As these veins are traced further away from the contact and into the granite, they are found to grow more narrow gradually until one of them was found to be only one foot wide at a point half a mile from where the contact was crossed. All of the oreshoots so far developed have been found within a few hundred feet of this margin.

Post-mineral faulting is quite prevalent in the vicinity of the deposits, but the vein displacement is usually not over 10 ft.. and more often it is 2 or 3 ft. The operator who finds his vein cut off by a fault should not be too readily discouraged. The United Silver-Copper vein exhibits a series of lateral step-faults with displacements averaging about 2 or 3 ft. Of larger faults, the Morgan fault, in the Loon Lake Copper deposit, with a throw of 50 ft. to the north, and the fault which displaces the east segment of the Bead Lake vein 135 ft. to the north, were the largest observed. There are many unmeasurable faults along the plane of the veins, as evidenced by slickensided wall rocks and streaks of gouge painting the walls of many of the deposits.

Few Bonanza Deposits in Washington

Washington has produced few ore deposits of the bonanza type. The Electric Point mine, discovered in 1914, is one of the really spectacular mines. There are several disseminated low-grade deposits of gold and copper ore in northern Okanogan County which show some promise of developing extensive tonnages of low-grade ore, but at present not enough systematic sampling or development work has been done to prove the properties. There exist, however, a number of small to medium-sized veins and other types of deposits, which, with the proper application of brains and capital, could be made to pay good returns. Barring a few isolated examples, the grade of ore in deposits throughout the

[1]Daly, R. A.: C. G. S. Memoir No. 38, p. 429.

state is not sufficiently high to be steadily and economically worked without concentration.

As a general statement, it can be said that the veins are capable of an average length that is good for veins of their width. Many of them have already been proved to extend to a good depth. The United Silver-Copper vein has been followed to a depth of 1,140 ft. below the outcrop, without decrease in size or metallic contents. Several of the other properties have attained depths of 500 to 800 ft. with no signs of the ore bottoming. Many of the smaller mines are worked intermittently and with limited capital, which condition has served to confine the developments to shallow workings.

Necessity of Concentrating Better Recognized

So far as can be foretold, Washington will not lose ground as a producer of metals during the next decade. The production can be expected to come largely from concentrated ore. The state as a whole has been backward in employing efficient methods of concentration, but decided improvement has been made in the last two years, and several well-designed, small mills are now under construction. A number of worthy properties are now idle because of lack of capital to permit work on an efficient scale and the need of skillful management. A number of such properties should develop into paying mines.

The promising ore deposits of the Northwestern States have not been combed over so thoroughly by capable mining organizations as is generally believed. The haphazard methods of development, often of the "shoe-string" kind, now in vogue, do not achieve satisfactory results. The gap between the promising prospect or semi-developed mine and a producing mine can best be bridged by well-organized and well-financed mining development companies with a staff of competent engineers. When there is a more dependable market, prospecting will be accelerated and new finds made.

Summary

In summarizing it may be said that:

1. The metalliferous ore deposits of Washington are genetically related to batholithic intrusions of granitic rocks.

2. In Stevens County and northern Pend Oreille County the ore deposits are found inclosed in Paleozoic metamorphosed sediments and closely associated with dikes genetically related to underlying granite. The dike intrusions are believed to have preceded the veins and assisted in opening channels in the roof rocks for the hydrothermal ore-bearing solutions and gases which soon followed the dikes.

3. In Ferry, Okanogan and southern Pend Oreille counties the vein deposits for the most part are inclosed in granitic rocks but near marginal contacts.

4. The character of the invaded formations plays an important rôle in determining the size, shape, and character of the orebodies.

5. Favorable local conditions for the formation of veins are found around the periphery of granitic cupolas and near marginal contacts of granitic and intruded rocks. For example, several commercial deposits are found near the margins of a plunging contact between granite and a roof pendant of the intruded rocks.

6. The gold-silver ores of the Republic district represent a distinctly separate period of mineralization, and for that reason are not included in these generalizations. Field work has not been attempted in the western part of the Cascades, and no effort has been made to include that area in this report.

7. Most of the deposits are believed to have been formed at intermediate depths below the surface.

8. Active erosion has prevented the formation of extensive zones of secondary enrichment.

9. No mammoth, low-grade deposits have so far been developed, and as a general rule the deposits are not of the bonanza type. There are a number of medium-sized, worth-while deposits that contain considerable tonnages of commercial ore of milling grade.

10. There are promising properties, now semi-dormant, which should yield returns if operated by well-financed and well organized mining-development companies.

Manganese in India

In India, on the east coast in the Vizagapatam and Ganjam districts, Madras, is a unique group of rocks known as the Kodurite series, containing manganese garnet, manganese pyroxene, potash feldspar, apatite, and quartz. These rocks, supposed to be of igneous origin, have been deeply weathered and the manganese concentrated as oxides in the surface zone.

The manganese-bearing districts form a belt that extends from Baroda, on the west coast, across northern India nearly to Calcutta on the east, a distance of 700 miles. In these districts, beds of manganese oxides, with manganese, garnet, and rhodonite, form a rock type known as gondite, which is interlayered with quartzite and mica schist.

The orebodies are lenses and layers. The largest single deposit, Balaghat, has the form of a shallow trough, is 1¾ miles long and 45 to 50 feet thick, and yielded from 1901 to 1913 a total of 725,248 tons of ore. In 1913, thirteen distinct deposits had yielded more than 100,000 tons each, the range being from 101,721 to 725,248 tons.

The annual production of manganese ore in India rose steadily from 1892, when the first shipments were made, to 1907, when 899,055 tons was shipped; and since then has ranged from 450,000 to 815,000 tons. The total production, up to and including 1916, was 8,748,000 tons.*

Cost of Building the Alaskan Railroad

Colonel Frederick Mears, chairman of the Alaskan Engineering Commission, has recently submitted the cost of several sections of the Alaskan Government Railroad. The most expensive section is an 11-mile stretch from Riley Creek to the foot of Nenana Canyon, which it is estimated will cost about $157,000 per mile upon completion. The northernmost section of fifty-six miles along the north bank of the Tanana River to Fairbanks is the cheapest part, at $43,700 per mile. Most of the first 260 miles has now been completed, as well as the last 100 miles. The total length is 468 miles.

Early Use of Copper Coins

Coins made from copper mined on the Island of Cyprus by the Phœnicians were used as medium of exchange by the early Meeditèrranean traders.

*D. S. Hewett in "Political and Commercial Geology," McGraw-Hill Book Co., 1920.

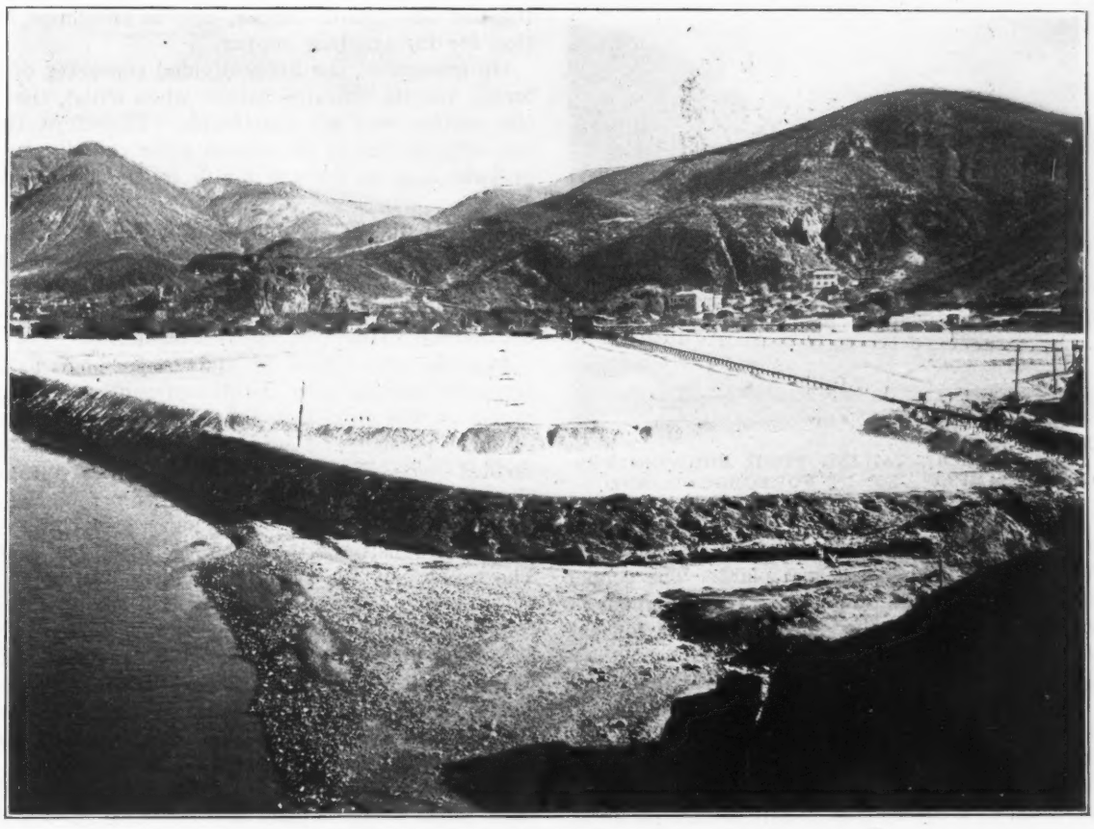
Leaching and Concentrating Mixed Copper Ores

Method Used at Experimental Plant of Arizona Copper Co., Ltd., at Clifton, on Old Tailings, Consists in Regrinding, Dissolution of Oxidized Copper in Weak Sulphuric Acid, and Flotation of the Sulphide Slimes

BY ARTHUR CROWFOOT AND KENNETH H. DONALDSON
Superintendent of Concentrators and General Foreman of No. 4 Concentrator
Written for *Engineering and Mining Journal*

EARLY in 1917, experiments made by the metallurgical staff of the concentrating division of the Arizona Copper Co. on mixed ores showed that 75 per cent of the acid-soluble copper was readily soluble in a dilute sulphuric-acid solution, if the ore were crushed to pass 35 mesh. Finer grinding was recommended to hasten the results and to increase the extraction. Coincident tests made upon old tailing material from the Clifton ponds indicated that these tailing deposits could be worked successfully by a combined leaching and flotation process. A continuation of the experiments during 1917 and 1918 on a larger scale resulted in the presentation of several proposed flow sheets for a combined leaching and flotation plant, using a counter-current decantation tank system for the recovery of the copper-bearing solution from the pulp, precipitating launders containing scrap iron for the precipitation of the copper from solution, and flotation cells for the recovery of the sulphide copper. Also, a ten-ton experimental leaching and decantation plant was erected at the Clifton concentrator, to treat current tailing product from the mill for the recovery of the contained acid-soluble copper.

Experiments were made on the current mill tailings from concentrator No. 4 for the recovery of its acid-soluble copper content during the period September to November inclusive, 1918. These were discontinued because the acid-soluble copper of the ore treated in the mill dropped to a point which made consideration of its recovery by a leaching process inadvisable. In this process the acid-soluble copper content of the mill tailings was concentrated in the slime portion of the tailings by a de-sanding operation performed by an Allen cone which preceded leaching and decanting operations.



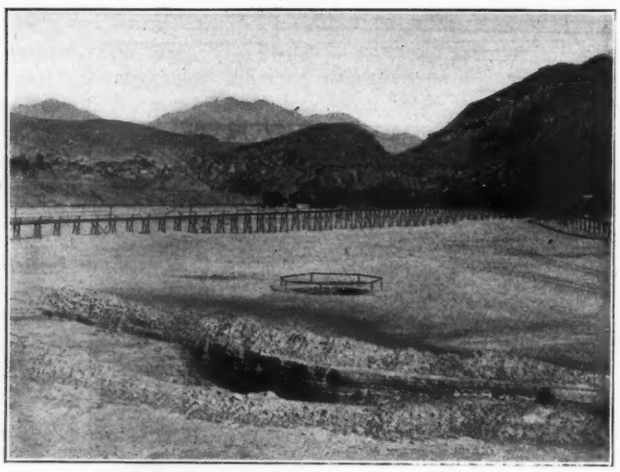
THE SLIME TAILING PONDS IN SOUTH CLIFTON

The treatment of the old Clifton tailings in the experimental leaching plant had been considered, and it was decided during November, 1918, to make the necessary changes in the plant for the treatment of this material. These consisted chiefly in the addition of a pebble tube mill to reduce to the required size any coarse sand which might be encountered and also to act as a disintegrator for lumps of slime; and in the addition of a flotation unit so that the sulphide copper might be recovered from the underflow of the last decanting tank. The required changes were started in December, 1918, and finished in January, 1919.

The plant was put into operation on the treatment of the old tailing material on Jan. 25, 1919, and operated under the conditions of flow sheet No. 1 until May 13, 1919, when flow sheet No. 2 was put into operation. The plant operated under the conditions of flow sheet No. 2 until July 10, 1919.

Material in Old Tailing Ponds Utilized

The material upon which the test work was performed consisted of representative samples of the tailing slime contained in the old tailing ponds in South Clifton. The banks of these tailing ponds are constructed of tailing sand having a maximum size of grain of between 1.5 and 2 mm.; and 93 per cent of the material in the ponds is fine enough to pass through a 200-mesh sieve which has openings .074 mm. square. The sandy material forming the banks of the ponds constitutes only a small



SOUTH CLIFTON SLIME TAILING POND, SHOWING PRELIMINARY SAMPLE CUT IN FOREGROUND AND TEST PIT IMMEDIATELY BEYOND

percentage of the total deposit, and this material was not included in the feed to the test plant. The copper in this sandy material will, however, be readily amenable to recovery by the same flow sheet proposed for the treatment of the slime.

The deposit consists of a mixture of practically untreated "oxide" slime and the slime tailings from a sulphide mill. The "oxide" slime originated in a concentrating plant which preceded the old leaching plant at Clifton, the oxide ore being treated in a Hancock jig for the removal of a coarse concentrate before leaching. The slime was then removed from the jig middling and sent direct to the ponds without further treatment. The deslimed jig middling was sent to the leaching plant. (See Greenawalt's "Hydro-metallurgy of Copper," p. 183.) The tailings from the sulphide mill were desanded by the use of a special form of elevator, the slime joining the "oxide" slime in the ponds, and the sand being hauled away in railroad cars to form the banks of the ponds and for other purposes.

The slime mixture as it occurs in the ponds has the appearance of a stiff clay and contains 20 per cent by weight of moisture. The material settles slowly, average results showing that about 30 sq.ft. of settling area is required per dry ton of material to obtain a Dorr tank underflow with a density of 50 per cent solids, as was required. Large tank areas are therefore necessary. For instance, to settle 100 tons of the slime from a density of about 25 per cent solids (the density leaving flotation cells) to a density of 50 per cent solids, a tank 60 ft. in diameter is required.

The thorough sampling of the slime deposit progressed with the experimental leaching and flotation work. In all, thirty test pits were sunk, these being regularly at the corners of rectangles. These pits were 8 ft. square and were continued to the bottom of the deposit, varying from 9 to 16 ft. in depth. A hole about 2 ft. square was dug 2 ft. deep in the center of the bottom of each test pit to prove the bottom. A total sample of about 1,200 dry tons was obtained, which assayed as follows:

	Total Cu	Acid-Sol. Cu	Water-Sol. Cu	Sul. Cu
Assay, per cent	1.39	0.85	0.06	0.48
Per cent of total Cu	100.00	61.20	4.30	34.50

Small- and large-scale laboratory tests indicated that at least 75 per cent of the total copper in the slime was readily recoverable by subjecting the slime to a comparatively short dilute sulphuric-acid leach for obtaining the acid-soluble copper, and to treatment by flotation for the sulphide copper.

On account of the finely divided character of the material, and its cohesive nature when moist, the percolation method was not practicable. Therefore, the leaching solution had to be applied after the slime had been brought into the form of a pulp by the aid of additional water.

The density of the pulp had to be kept as high as was consistent with the necessity of obtaining thorough agitation with the leaching solution, so that the required degree of acidity in the leaching solution might be maintained without excessive use of acid.

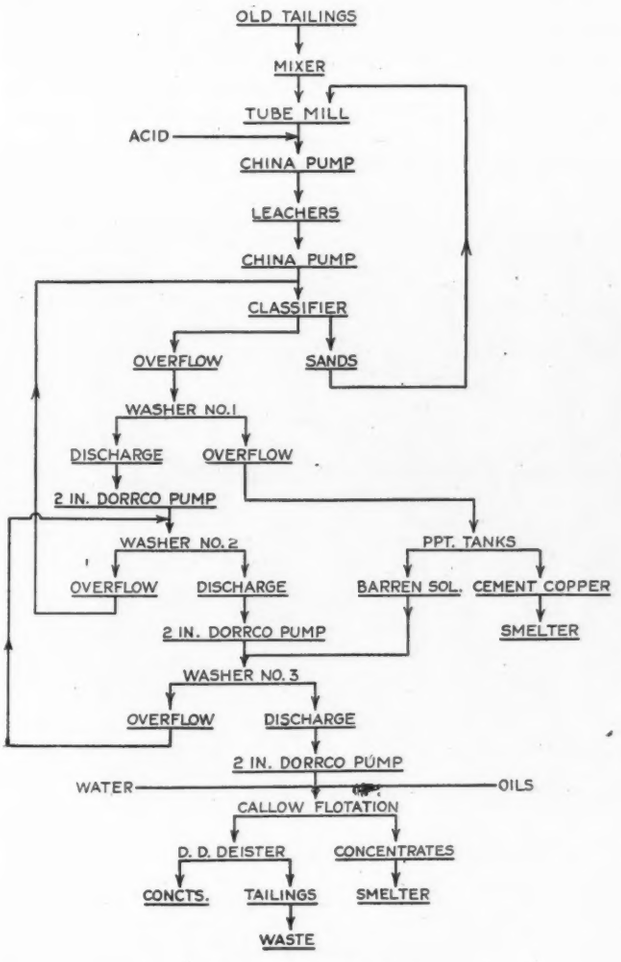
For the separation of the copper-bearing solution from the leached pulp, counter-current washing and decantation was employed, the conditions being analogous to those existing in cyanide plants working on finely divided gold. Flow sheet No. 1 shows the arrangement. The slime lumps were first broken in a mixer somewhat similar to a small-scale log washer, water being added to bring the density of the discharge to 50 per cent solids. The mixer put the slime in condition to be picked up by the scoop feeder of the tube mill which immediately followed it. The tube mill used was 5 ft. in diameter by 12 ft. long, direct-connected to a motor, and lined with Danish pebbles set in cement. Danish pebbles were also used for a grinding medium. Sulphuric acid was added at the discharge of the mill, the pulp then being delivered to the leaching tanks. Nos. 1, 2, and 3 were wood-stave tanks 9 ft. 6 in. in diameter and 10 ft. deep, these tanks being in place and available for use for this purpose.

Pulp was transferred from one tank to the next by the use of air lifts. These consisted of a square wooden pipe of 2 in. inside cross-section, made up of two pieces of 2 x 2 and two pieces of 2 x 6 nailed together with copper nails. The air pipe was a ¾-in. rubber hose which discharged directly into the pulp, no footpiece being used. Although this type of lift was not efficient in the use of air, it worked satisfactorily for test purposes, and with a pulp containing 50 per cent solids the submergence was frequently as low as 25 per cent.

The air used for regular operation was that supplied by a No. 3 Root blower, which also supplied the air for flotation and the air lifts for the washing tanks. The discharge launders from the air lifts were arranged so that any proportion of the material lifted could be returned to the same tank. The return gave an excellent mixture of the pulp as well as simplifying the regula-

tion of the advance. These air lifts have since been replaced with Dorrco pumps, as it was desired to test this type of pump. They will probably be more economical in the use of power.

The leached pulp from the tanks was delivered to a drag-belt classifier, which returned the sands to the tube mill for regrinding and a slime product to the washing



FLOW SHEET NO. 1

and decanting tanks. The necessary dilution of the leaching tank discharge preceding classification was accomplished by the use of return solution from the overflow of the second decanting tank in the three-tank system.

Air Lifts Replaced by Dorrco Pumps

The washing and decanting tanks used in flow sheet No. 1 were 16 ft. square, and were in place, having been used in a previous test on current mill tailings. They were equipped with air lifts for the transfer of the settled solids, similar to those already described. These lifts were not satisfactory, owing to difficulty in controlling the amount of thickened pulp raised. They were therefore replaced with 2-in. Dorrco pumps, which gave good service, requiring a minimum of repairs and operating attention.

The pulp discharge from the third washer in the series was sent to a standard Callow 8-ft. flotation cell, which produced a rough concentrate and a tailing product. No cleaner cell was installed, but periodical tests showed that a high-grade sulphide concentrate could be produced.

The tailings from the flotation cell were at first retreated on a Deister table, but this operation was later discontinued as unnecessary.

The results obtained with flow sheet No. 1 were as follows:

	Assay, per Cent			
	Total Cu	A.-S. Cu	Sul. Cu	W.-S. Cu
Feed to plant	1.41	0.87	0.51	0.03
Leaching-tank discharge	1.14	0.22	0.43	0.49
Washing-tank discharge	0.73	0.21	0.42	0.10
Flotation tailings	0.31	0.13	0.11	0.07

Acid Consumption (Lb. 60 Deg. Bé.)

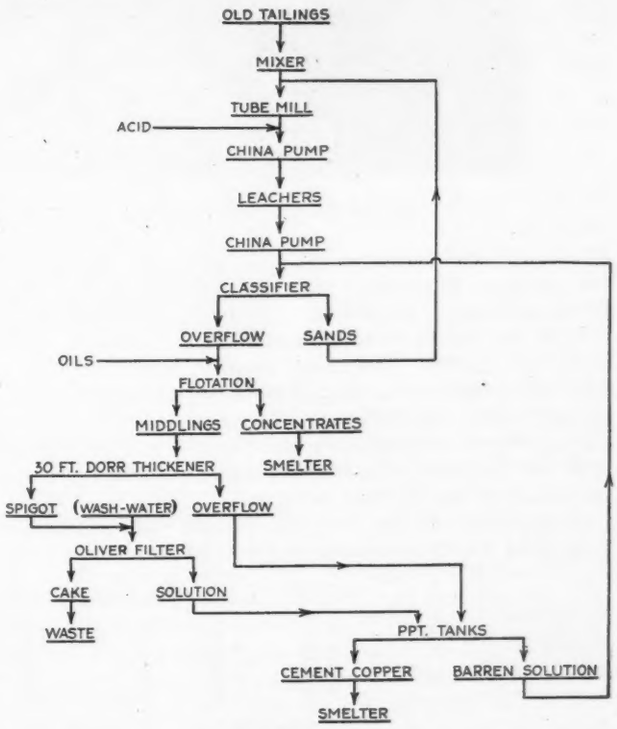
Per dry ton of material treated	51.14
Per lb. of total copper in feed	1.81
Per lb. of A.-S. copper in feed	2.94
Per lb. of A.-S. copper recovered	3.71

Over-All Extraction or Recovery

Per cent of total copper	79.57
Per cent of acid-soluble copper	79.35
Per cent of sulphide copper	79.96
Per cent of water-soluble copper	86.72

The recovery of water-soluble copper would have been increased had not some difficulty been encountered in holding the discharge of the washing tanks at the correct density.

Because of the slow settling of the suspended matter, already mentioned, it was decided to try out a combined decanting tank and vacuum filter flow sheet, limiting the decantation to one tank followed by a continuous vacuum filter. The flow sheet was, therefore, rearranged as shown in flow sheet No. 2. Both flow sheets are identical up to the point where the discharge from the leaching tanks is sent to the classifier. Following this



FLOW SHEET NO. 2

point, in flow sheet No. 2, the copper-bearing solution is recovered partly by tank decantation and partly by filter decantation; also, there is a notable difference in the location of the flotation system in the flow sheet. In No. 1 flotation is the final operation, the table which followed having been discarded as unnecessary, the

sulphide copper being floated from a pulp containing practically barren solution.

In flow sheet No. 2 flotation precedes the decanting and filtering system and receives its feed from the overflow of the classifier which immediately follows the leaching tanks. The sulphide copper is, therefore, floated from the solids contained in a lean copper-sulphate solution. The flotation tailings are sent to the decanting and filtering system, and the final waste tailings of the process form the filter cake. Laboratory tests had proved that sulphides can be floated as readily in lean copper-sulphate solutions as in barren solutions, and this has been checked and confirmed in test-plant operations.

Arranging the flotation system as in flow sheet No. 2 eliminates the necessity of re-pulping the filter cake for flotation treatment, and the problem of disposing of the tailings is simplified.

That the results obtained under No. 2 conditions were more satisfactory than under those in flow sheet No. 1 was due largely to a higher recovery of water-soluble copper. Also, the flotation tailings produced were 0.04 per cent lower in sulphide copper, and it was considered that the presence of a slight amount of free acid was beneficial to the flotation process.

A summary of the principal results obtained under flow sheet No. 2 conditions is given below:

	Assay, per Cent			
	Total Cu	A.-S. Cu	Sul. Cu	W.-S. Cu
Feed to plant	1.36	0.79	0.44	0.13
Leaching-tank discharge	1.12	0.22	0.35	0.55
Flotation feed	1.43	0.23	0.47	0.73
Flotation tailings	0.90	0.12	0.09	0.69
Washing-tank discharge	0.33	0.09	0.08	0.16
Filter-cake tailings	0.22	0.10	0.07	0.05

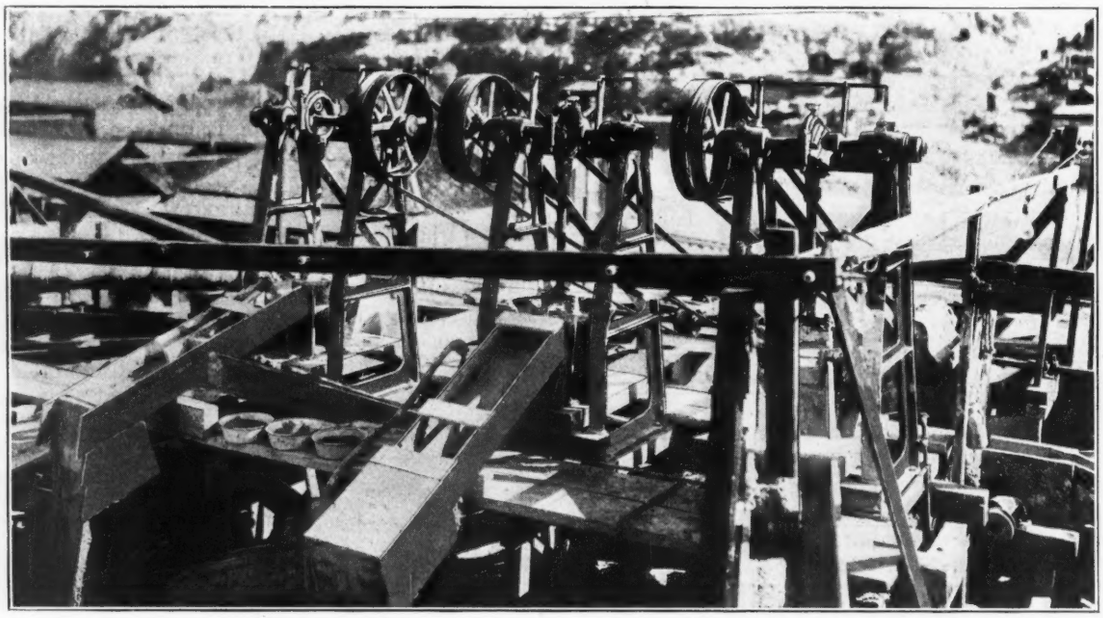
Acid Consumption	Lb., 60 Deg. Bé.
Per dry ton of material treated	59.08
Per lb. of total copper in feed	2.17
Per lb. of A.-S. copper in feed	3.74
Per lb. of A.-S. copper recovered	4.40

Over-All Extraction or Recovery	
Per cent of total copper	84.57
Per cent of acid-soluble copper	84.93
Per cent of sulphide copper	82.70
Per cent of water-soluble copper	91.18

The sands from the classifier being returned to the tube mill, the total copper is lower in the leaching tank discharge than in the feed to the plant, in both flow sheets Nos. 1 and 2. The tube mill, leaching tanks, and classifier operate in a closed circuit. The flotation feed is higher in total copper than the feed to the plant, because the return solution used for diluting the classifier feed contained a small amount of copper in solution, which material was included in the flotation-feed assays.

Flow sheet No. 2 gave satisfactory results if the copper was to be precipitated by the use of scrap iron or sponge iron, and for the slime deposit this method of depositing the copper no doubt will prove to be the most economical.

Recovering all copper-bearing solution by the use of continuous vacuum filters is now proposed, in which operation the leaching-tank discharge will be sent directly to a filter equipped to produce possibly three grades of solution. Recovery of the sulphide copper will not then be attempted until after the copper-bearing solution has been removed from the pulp. The filter cake will be repulped and sent to the flotation system, the flotation rougher cell tailings again forming the general tailings of the system.



DORRCO PUMPS TRANSFERRING PULP FROM ONE LEACHING TANK TO ANOTHER

If it is found possible to construct tailing dams from this dilute tailing pulp of very finely divided solids, so that clear water may be recovered, the use of tanks for the reclamation of solution or of water will be entirely superseded. However, employing of tanks to reclaim the tailing water may be found economical if used in conjunction with the tailing dams as water reclaimers. The main benefit to be derived from the use of the tanks will probably be a better control of the dilution of the copper solution and the production of a higher grade of copper solution.

Crusher, screen, roll, and primary table equipment have been added to the plant to make possible the handling of mixed run-of-mine ores. A roasting furnace and SO_2-leaching drum are also being installed at the plant, so that the cheaper sulphur dioxide may be tried on ores which contain a high percentage of acid-soluble gangue.

Mine Operators of Note

James MacNaughton

VISITING Institute members in the Michigan Copper country were impressed by several interesting facts, and among them was the realization that of all the influences which have directly affected the upbuilding of that section perhaps the greatest is the Calumet & Hecla Mining Co.—the largest operating company in the district. The mines, mills and smelter operated by the C. & H. (no one ever speaks of the company by its full title) all show the influence of a guiding spirit; the effect is that of a well-balanced piece of machinery, each unit working with precision under the touch of a master engineer. Large-scale operations require big-thinking, able men who are learned in the school of experience and who combine with their acquired knowledge of affairs a keen understanding of human nature. Such a man is James MacNaughton, vice-president and general manager of the Calumet & Hecla Mining Co., and, in addition, general manager of all the subsidiary companies of the parent organization. Born in Canada in 1864, of Scotch parents, young MacNaughton, after attending high school, entered the University of Michigan, where he studied civil engineering. There were no frills in those days, and his education was obtained by dint of hard work which brought out those admirable qualities that Mr. MacNaughton so well displays in his management of affairs today. He played football, and, as with everything else, successfully. It is the remembrance of those early days that has produced the enthusiasm and interest which he shows in the sports of the copper district and in the excellent school system that stands second to none in the country. It is quite probable that Mr. MacNaughton would have attended the Michigan School of Mines had that institution been established at the time he entered college, but it was not until 1885 that this excellent college—now the Michigan College of Mines—was founded. However, Mr. MacNaughton has always displayed a keen interest in the school at Houghton, and much of the prestige enjoyed by its graduates and the school itself is due to his advice and counsel. Many of the able members of his staff are "M. C. M." men, and frequently he consents to address the student body on matters concerning their chosen profession. As with many others, Mr. MacNaughton's course in civil engineering was merely the stepping stone to mining, and upon entering the employ of the Calumet & Hecla company his advance was rapid. He was, and is, big, generous, intelligent and resourceful, and above all has that deep insight into human nature which has come to be recognized as prerequisite in the modern administrator and which is the biggest asset of the successful man. One has only to study the record of the Calumet & Hecla to note what that organization has accomplished in the development of a community spirit in the copper country, its methods of handling men, the bonus and pension systems, free insurance for its workmen, and other examples of welfare work, to realize that such undertakings must require the supervisory services of a man of broad mental measurement. Certainly the copper country and the Calumet & Hecla are to be congratulated on "Jim" MacNaughton. He is a member of the American Institute of Mining and Metallurgical Engineers, of the Lake Superior Mining Institute and of the Institution of Mining and Metallurgy (London). He was, and is, keenly interested in politics, having been a delegate to the Republican National Convention at St. Louis in 1896, and also a delegate-at-large from Michigan to the Republican National Convention in 1908. From this we may assume that politics, contrary to the opinions expressed by many engineers, was considered by James MacNaughton to be a good game, for if it were not he would have had little to do with it. His devotion to the welfare of the industrial communities of Michigan should prove an inspiration to the engineering profession.

JAMES MacNAUGHTON

Despite Mr. MacNaughton's many interests he finds time to give consideration to good roads, and to the programs for other public improvements which his section of northern Michigan has so well put into practice. He is a member of the University Club of Chicago, the Tennis and Racquet Club of Boston and the Links Club of New York.

The Railroad Situation

By R. S. McBride
Engineering Representative, Washington, D. C.

NEVER within any similar short period have three such far-reaching steps been taken in the American railroad industry as have been made during the last few weeks. The railroad wage award has doubtless affected more workers and influenced wages in a larger total sum than any other similar award in history. Certainly at no time has a regulating authority ever before in one single order created rate increases amounting to a billion and a half dollars per year.

The discharge of nearly 10 per cent of its workers by one of the large eastern railway systems is almost correspondingly drastic in its significance. Apparently labor as well as the rest of the community understands this last event to mean that slothful service in return for reasonable wage is no longer going to be tolerated. Persistent report of appreciable unemployment throughout the country indicates that the railway labor situation is not alone affected thus. The limited ability of the transportation systems to move materials needed for construction and industrial-plant operation accounts in part for the appreciable shortage of employment, but there seems to be at present a general feeling that a decision on the part of management officials is even more potent an influence to this end.

Almost without exception those who have commented upon the railway labor situation believe that increasing efficiency in performance of labor will certainly result from recent events. The increase in wage will render willing workers more content and better disposed toward their employment; the executive policy referred to will mean the elimination of the unwilling employee. It is, therefore, not too much to expect an increase in operating efficiency during the coming months which will perhaps amount to as much as $100,000,000 per year in benefit to the railway systems.

The Accounting Significance

The Interstate Commerce Commission is specifically instructed by Congress in the transportation act of 1920 to regard 5½ per cent as a fair return upon railway values plus an allowance of not to exceed one-half of 1 per cent, this to be fixed in the judgment of the Commission as an allowance for improvements, betterments, or equipment which are chargeable to capital account. The recent decision, therefore, is based upon these terms and is intended to provide a net operating income to the utilities of 6 per cent upon a value of approximately ninteen billion dollars.

There has been very general favorable comment upon this finding. By some it is regarded purely as a reasonable return for current operation of these public corporations. Others, however, believe that the Interstate Commerce Commission took an even more advanced view. Those who hold this latter opinion say that the Commission, realizing that earlier returns had been wholly inadequate, intended to fix the returns at a point which would permit the utilities to catch up on their deferred maintenance work. Of course, if this is the fact it makes little difference whether it is considered to be a recognition of need for adjustment of past returns, which were too low, or it be assumed that these items were deferred from earlier periods, when they were properly chargeable to operating expense, and now, therefore, are properly included in the coming years' operating expenses. The economic significance is the same, though the accounting and legal meanings may be quite different. No matter which one of the several views mentioned is held, it is almost always found that railway students regard the rate increase and the present situation most encouraging to industries as a whole. Great improvement in transportation facilities and service are generally anticipated. If they are realized, all industrial activity will quickly profit.

The effect of the railway situation upon cost of living by and large to the community is too complicated to forecast for the immediate future. However, even though the ultimate user finds the whole increase passed on to him in the prices of commodities which he buys, he can feel some degree of reassurance in the fact that facilities are being provided whereby *future* transportation of *similar* commodities can be more effectively accomplished. Taking the present coal situation as a striking example of the benefit of this, it is evident that the user of this commodity will ultimately profit greatly by paying the higher transportation charges. The coal situation is as follows:

Factors Affecting Coal Prices

The high prices of coal, both bituminous and anthracite, have been in large measure, if not wholly, the result of two factors: (1) a slight under-supply, and (2) an excessive panic with respect to shortage. It is well known that even a very small percentage of demand above supply creates large percentage increase in prices. This has been all too evident in the coal situation recently. Spot coal prices have been extremely high, and wholesalers handling coal on contract from the mines for current sales not under contract naturally have taken advantage of the current spot market. The margin between the spot market and the contract market has thus been very great, and hence the temptation to break contracts has been most unusual. Doubtless the violation of contracts by producers of coal has, therefore, been unprecedented in amount recently; and what should have been contract coal became spot coal subject to all the fluctuations and competitive demand. As a result almost everyone who had to buy during recent months has been compelled to pay a high price.

The fundamental cause of the entire coal shortage has, however, been the inability to provide cars for the prompt movement of coal, which coal could be produced in quantity far in excess of current demand were cars available. Let us assume that a reasonable policy of improved coal-handling facilities is adopted and that part of the billion dollars per year increase in railway net income is expended for this needed equipment. In a single year the purchasers of coal should be relieved of all fear of coal shortages and excessive prices similar to those now confronting them.

Krupps After Russian Iron Ore

A Berlin correspondent of *The Iron Age* reports that Krupp prospectors are investigating the large fields of magnetic iron ore located by the late Professor Leydt at Kursk, in South Central Russia. These so-far unworked ore fields, according to Leydt and two Swedish engineers who have checked his observations, extend in parallel bands for a distance of 180 kilometers, and are among the greatest deposits of magnetic ore in the world.

BY THE WAY

More Points on Technical Writing

During the course of a dinner at which the members of the Bureau of Mines staff gathered recently, John L. Cochrane, the director of the Bureau's publicity division, was asked to discuss the following topic: "If you had the power to develop a writer of technical matter, what course would you adopt?" A portion of Mr. Cochrane's reply is as follows:

First of all I would catch him young and feed him on alphabetical crackers to insure that he became a man of letters. Then I would give him a careful diet of raw bull to strengthen his nerve—the one most essential thing to technical writing.

I would teach him that the other man in the same line of work is always wrong: can't possibly ever be right. (You could prove that through the fact that he indulges in technical writing.) I would attempt to teach him that clearness is fatal to any technical writer. I would drill into him daily, "Kid, obscure your meaning, and you will become famous." Then it will give you a convenient loophole to escape if you ever have to. If anyone attacks you then you can very easily call him "another," because in reality you, yourself, if honest with yourself, as you sometimes should be, do not quite know what you mean yourself. In that way, you'll have it on him, even though he won't know. Anyway, a conscience is sometimes convenient, even to a technical man.

If you want to throw a few additional smoke screens into the article, which is always desirable, puncture it with stars, asterisks, crosses and other mysterious marks, the harder to understand the better. Then have a number of footnotes that correspond, but mean nothing. Be sure that you refer as authority to some society that you defy him to find out anything about, such as "Flannigan in the May, 1852, proceedings of Erin-go-Bragh." Make it as difficult as possible for your reader to follow; that's genius.

And here is some advice that ought to be italicized: If you disagree with another author and want to pillorize him before your technical disciple (you really care about nobody else) put in an extra footnote and refer to him as the authority for something you know is wrong. If done naively, it has the effect of T.N.T. The ordinary effort of the layman in such matters is childish in comparison.

Always quarrel with your scientific brother in a dignified manner. Begin with, "May I have the honor to explain." The beauty about such open, gentlemanly controversy is that you may quite as often be as near right or as near wrong as the other fellow. I stress this, because I feel it is an important accomplishment in technical writing. How fully equipped is a technical writer who can tell a man he is a damn fool in language that leaves him flattered!

Then by all means, if you are a Government technical employee, have at least three or four other technical employees read critically your manuscript before it is ready for the printed page. The beauty here lies in the fact that when they get through with it all such annoying superfluities as personality of the author have disappeared. Don't bother about the lack of capabilities of those who read the manuscript. The chances are that unconsciously they may improve it, as in the case of the hitherto homely person who developed into a handsome man after a horse had stepped on his face. And during this process of critique, if you ever wince when they put the hot iron into your soul, you will never make a technical writer, and therefore there may be some hope for you.

And please remember as a technical writer that nothing is ever perfect. If you are in a great art gallery and the simple-minded folk are admiring the Venus de Milo in their crude, enthusiastic way, remember your training and take issue with the work. Suggest that it is not true to nature because it does not have one or two warts on the feet. Point out that there are no varicose veins on the leg.

I almost forgot to say that brevity, being the soul of wit, has no place in a technical article.

If the dream child that I have instructed (and he is no synthetic kid) can follow me, it may be said of him with apologies to Kipling "Then you'll be a man, my son; you'll be a man."

Typewritten in the Clouds

P. R. Coldren, editor in charge of editorials and mining for the *Joplin Globe*, believes he is the first newspaper man in the country to write an editorial in an aeroplane. He made his first flight on Friday, Aug. 13, just to show his scorn of superstition, and in order to feel perfectly at home, took along a small portable typewriter, tied securely to his knees. The editorial he wrote he admits was not literature, but he is going to claim that it is the first written on a typewriter in an aeroplane, until he learns differently. Mr. Coldren is an honorary member of the American Zinc Institute and had a place on the program at the recent annual meeting in Chicago.

Engineer and Inventor

Pedro Zamora, the Mexican bandit, recently captured Charles Hoyle, of Esperanza, Ltd., as recounted in the daily press, whereupon a certain New York paper stated, "Hoyle is a nephew of the American inventor, John Hays Hammond." What's the use of being an engineer, after all, and famous (so we think) at that?

Rolling Stones

That mining need not be an ephemeral occupation is indicated by the records of a few old-timers in the Globe district in Arizona. Sam Richmond, who worked the first silver claim in Richmond Basin about forty years ago, is still working a claim there at the age of seventy-seven and recently received $200 from a single sackful of silver ore shipped by him. Fred Hefty, also seventy-seven years old, has lived at McMillen for forty-three years, and Charles Newton, caretaker at the old McMillen mine, has been in the camp for over forty years, though it has long been practically deserted.

A Classic Allusion

"On one occasion in 1849, for instance," says Hittel in his "History of California," "when William B. Almond was trying a trivial case in San Francisco, the attorney for the plaintiff, in what he considered a sudden burst of inspiration, called his opponent an oscillating Tarquin. 'A what?' exclaimed the judge in a stentorian voice. 'An oscillating Tarquin, Your Honor.' At this the judge, who was entirely unacquainted with Tarquin and had probably never before heard the word 'oscillating,' removed his feet from the table in front of him; and, leaning forward and pointing his index finger toward the offending disciple of Blackstone, he ejaculated in a voice of thunder, 'If this Honorable Court knows herself, and she thinks she do, that remark is an insult to this Honorable Court. You are fined two ounces and stand committed till you down with the dust.' 'But, Your Honor—' remonstrated the attorney. 'Silence, sir,' roared the judge, 'this Honorable Court won't tolerate 'cussing' and never goes back on her decisions.' It is almost needless to add that the fine was paid and the attorney more careful of classical allusions for the future."

CONSULTATION

The Future of Barytes

"In your Aug. 7 issue of the *Engineering and Mining Journal*, first article, the statement is made that the demand for barytes is increasing and its future is excellent. I would be glad to know why."

The demand for barytes is dependent upon its useful properties. There are three major uses for this material, which, in order of importance, are, in the manufacture of lithopone, as ground barytes (a white pigment, or base for paints), and in the manufacture of barium chemicals. Barytes has a wide variety of important applications that are continually being expanded. The greatest consumption is absorbed by the growing lithopone industry in the United States, whereby barytes and zinc are chemically and physically treated to form a valuable pigment (see July 17 issue of *Engineering and Mining Journal*.) It is the great demand for paint in the United States in connection with building and other construction which accounts for the present pressure to produce as much barytes as possible. The demand for barytes at the present time is larger than the supply, a condition that shows no indication of being mitigated for some time unless unexpected shipments of crude barytes from abroad should occur. It is essentially a producers' market.

The critical shortage of barytes is directly the result of the almost complete curtailment of imports of this material from Germany, where most of the foreign barytes formerly coming to the United States was produced. In previous years 25,000 to 30,000 short tons was imported annually. In 1916, 1917, and 1918 the imports totaled only twenty-three tons. Under these circumstances the domestic resources of barytes were called upon to fill the void left by decreased imports, with the result that the price of the product gradually increased. In previous years $3.50 per ton was considered a fair price for crude barytes. Present prices for the same class of material are between $10 and $12 per ton, an advance of about 250 per cent.

The attempt to replace the shortage of foreign ore by greater activities in the domestic barytes fields was handicapped by the smallness and frequently the isolation of the deposits. Ready accessibility is so lacking in some barytes mines that only with a high price of barytes—such as is ruling at the present time—can these operations continue. However, inaccessibility today may be accessibility tomorrow. The chief source—also the chief market—for barytes is in the East, and those mines in the Appalachians conveniently located as to markets are in for a prosperous period. The only dark outlook on the barytes horizon is the probability of the resumption of imports from Germany. There is little doubt but what Germany will be anxious to ship this material to the United States and furnish competition along the Atlantic seaboard which it will be difficult to meet under existing tariff regulations. The large deposits of Germany can be mined cheaply and the ad valorem duty of 15 per cent is a small protection to the industry. However, the possibility of Germany resuming the export trade quickly is not as probable as it may seem. Many difficulties will have to be surmounted before the readily available shipping facilities which that nation was accustomed to have before the war are again at its disposal. Furthermore, labor and political troubles have not been entirely eliminated. The importation of German barytes is still an uncertain element in the situation. Then there is the possibility, which ought not to be overlooked, that higher tariffs may be imposed to protect the American industry.

How long the present period of prosperity may continue no one can prophesy, but it seems certain that it will be for some time—until heavy importations from abroad are made. A much larger production than the present one could be easily absorbed, and search is being continually made for other deposits. A great part of the country's output is in the hands of the lithopone and other manufacturers, but these interests have been unable to fill their own requirements and are constantly in the market for the crude material. It is unlikely that the demand for this useful mineral will decrease in the next few years.

The following table summarizes the development of the industry in the ten years previous to 1919.

BARYTES PRODUCTION IN THE UNITED STATES, IMPORTS, AND AVERAGE PRICE 1910-1918

	Produced and Marketed in U. S.	Imports	Average Price
1910-1914 Average	43,389	28,800	$3.31
1915	108,547	2,504	3.51
1916	221,952	17	4.56
1917	206,888	6	5.66
1918	155,368	0	6.73

Cobalt-Nickel Smelters

"I would appreciate it very much if you would give me the names of some smelting companies that treat cobalt-nickel ores. There are some, I believe, in Eastern Canada and a few in England."

The following comprises a list of companies producing cobalt in North America:

	Location of Works	Post Office Address
Deloro Smelting & Refining Co., Ltd.	Deloro	Deloro, Ont.
Coniagas Reduction Co., Ltd.	Thorold	St. Catharines, Ont.
*Metals Chemical, Ltd.	Welland	Welland, Ont.
Standard Smelting & Refining Co., Ltd.	Chippawa	Niagara Falls, Ont.

In the United States, the Haynes Stellite Co. has a plant at Kokomo, Ind., in which it reduces cobalt ores mined at its property in Idaho. A former cobalt-nickel refinery at Fredericktown, Mo., was shut down in 1909, and to the best of our knowledge is not operating at the present time.

The domestic resources of nickel and cobalt are small. The nickel smelters and refineries in the United States, such as the International Nickel Co., work wholly on imported ore and matte coming from Canada or New Caledonia. The United States is not self-supporting in nickel requirements.

*Not operating.

THE PETROLEUM INDUSTRY

A Numerical Expression for Production-Decline Curves of Oil Wells

By Means of Mathematical Interpretation and Records of Formulæ Which Express Well Production It Is Possible To Avoid Bulky Data, and Curves May Be Conveniently Constructed as Desired

BY J. O. LEWIS* AND W. W. CUTLER, JR.†
Written for *Engineering and Mining Journal*‡

EXPERIENCE has shown that the production-decline curve follows an exponential equation of the type formula $y - a = k\ (x - b)^{-n}$. These curves have usually been recorded graphically on rectilinear or logarithmic co-ordinate paper. The recording of such curves by numerical rather than graphical expressions has certain features which are useful, particularly as thereby much data may be presented in condensed form. The method of deriving and recording numerical expressions for production-decline curves will be briefly outlined.

The production-decline curve shows the production of a well, tract, or field for successive periods, in terms of production. Thus for a well which produced during successive years 8,200, 4,900, 3,800, 2,450, 2,300, and 1,850 bbl., the production-decline curve would at successive equal horizontal intervals pass through points 8,200, 4,900, 3,800, 2,450, 2,300, and 1,850, respectively, on the vertical scale.

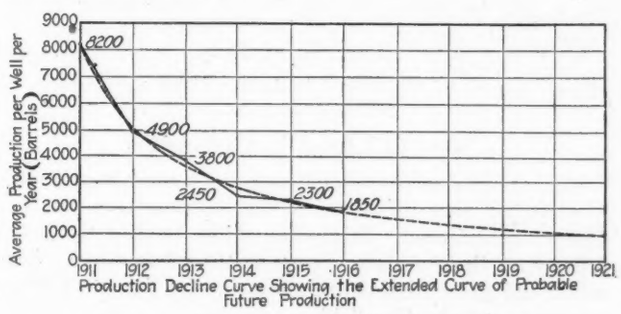


FIG. 1. PRODUCTION-DECLINE CURVE

Fig. 1, which illustrates a production-decline curve, is taken from p. 70 of the "Manual for the Oil & Gas Industry," for 1918, published by the Treasury Department. Such curves may be used to read past production and to estimate production in the future. Curves can be made by various methods for different fields or properties which usually reduce to hyperbolas when "ironed out." A collection of plotted curves is bulky and inconvenient to carry, whereas a simple numerical expression for each curve may easily be formed which will permit the reproduction of the curve when desired, and thus the curves for many fields may be carried on a single sheet of a notebook. The use of this method is confined to curves which closely follow a true hyperbola.

The method is as follows: Transfer the production-decline curve to logarithmic paper. Shift all points of the logarithmic curve the same number of units to the right or left until the curve approximates a straight line. To straighten always move the curve in the direction of its convex side. It may require several trials to determine the proper position of the curve.

In the accompanying illustration (Fig. 2) curves 1, 2, and 3 represent the same curve in different positions

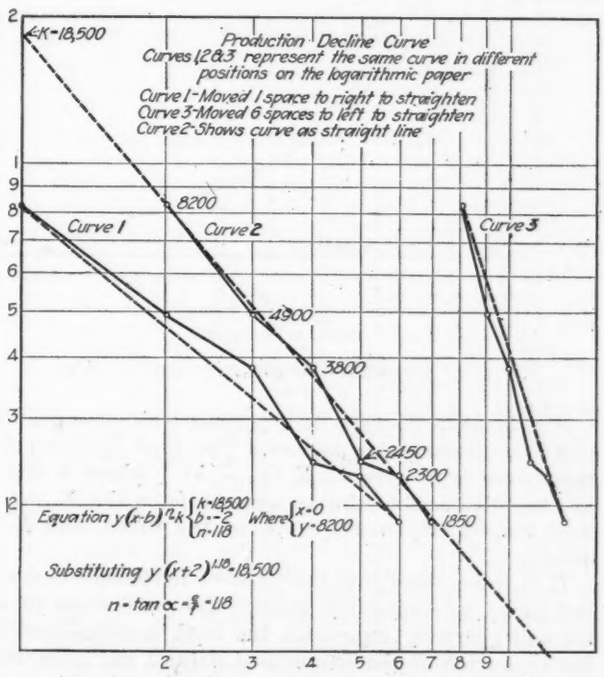


FIG. 2. LOGARITHMIC PRODUCTION CURVE

on logarithmic paper. Curve 1 was moved one unit to the right until it approached a straight line, as shown by Curve 2. Curve 3 was moved six units to the left until it occupied the position of Curve 2. A straight line can be drawn through Curve 2 so that it passes through or lies between all points of the curve and

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represents the mean average of the curve. This straight line represents the "ironed-out" curve and may be extended downward to read estimated future production, or may be extended upward in case the past production is not known.

Two points of a straight line on logarithmic paper establish a curve, and thus by recording the co-ordinates of two points on the "ironed-out," straightened, logarithmic curve a numerical expression for the production-decline curve is obtained.

To show which part of the curve represents the actual productive life of the wells choose the two points on the "ironed-out" curve where it crosses the beginning and the end of the period of production.

Thus in the accompanying illustration the record of these two points establishes that part of the curve representing the period of actual production:

$Y = 8200$ $\qquad$ $Y = 1850$
$X = 2$ $\qquad$ $X = 7$

(y = production in barrels, x = relative time in years; thus 2 = 1 actual time and 7 = 6 actual time).

These two points may be plotted on logarithmic paper and joined by a straight line when it is desired to reproduce the curve.

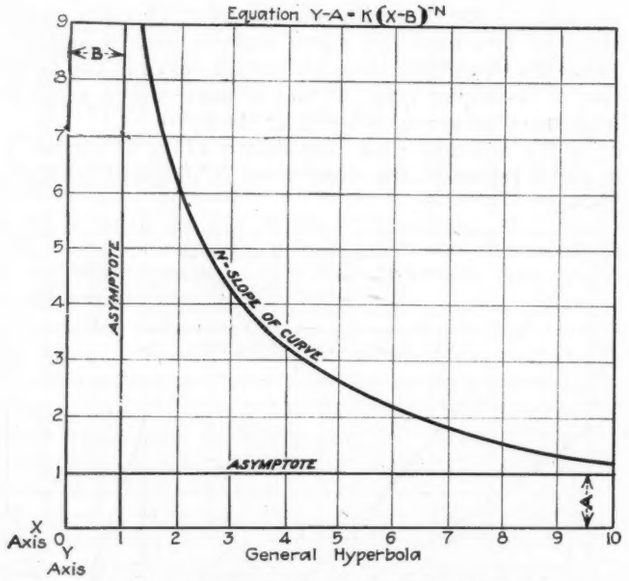


FIG. 3. HYPERBOLIC PRODUCTION CURVE

Fig. 3 shows the type of hyperbola which the production-decline curve approaches. The type equation for this curve is $Y - a = K\ (x - b)^{-n}$ where a and b are the distances of the asymptotes from the X and Y axes respectively, n the slope of the curve, and K, a constant.

It is to be noted that this type of hyperbolic curve is the curve for expanding gases. The production of an oil well generally represents the work accomplished by the expansion of the compressed natural gas associated with the oil in the sands. The production of oil in fields where recovery is caused mainly by expanding gases is essentially a problem in thermodynamics.

A production-decline curve begins theoretically at infinity production and zero time, but actually at some definite production, and the Y axis may be moved to pass through this point, thus throwing the asymptote to the left of the Y axis and making b a minus quantity. All points to the left of the Y axis thus become minus quantities, and hence imaginary so far as the well or wells are concerned. Time for the particular curve begins in the Y axis; thus in Curve 2, Fig. 2, 2 on the time scale becomes the first year, 3 the second year, and 7 the sixth year.

The production curve may be theoretically considered as ending at zero production and at infinity time. Thus a becomes zero and the asymptote coincides with the X axis. Actually the curve terminates where production ceases for whatever reason—usually where it has reached, or is estimated will reach, the economic minimum of production. n, the slope of the curve, may be determined by plotting the production decline curve as a stright line on logarithmic paper and then scaling the tangent of the slope as in Fig. 2, where tan $\alpha = \frac{e}{f} = 1.18$.

K is a constant and may be determined graphically from the straightened logarithmic curve, as it is the value of Y where the curve crosses the left side of the logarithmic paper at one on the abscissa from the asymptote. In Fig. 2, $K = 18{,}500$. K may be determined mathematically by substituting the already determined values of n, b, and x and y for any point in the equation:

$$y - a = \mathrm{k}\ (x - \mathrm{b})^{-n} \text{ where } a = o,\ y = \frac{k}{(x - b)^n} \text{ or}$$
$$y(x - b)^n = k.$$

In Fig. 2 n was recorded as 1.18. The highest recorded production was 8,200, which lies on the straightened logarithmic curve where the abscissa equals 2. b, therefore, for this curve, is —2. K, which equals value of y where curve lies at abscissa 1, equals 18,500. The formula for this curve thus becomes

$$y(x - b)^n = K, \text{ or } Y(x + 2)^{1.18} = 18{,}500.$$
$$\text{Where } x = o,\ Y = 8{,}200.$$

When the value of n is high, and it sometimes approaches 20, the determination of n must be very exact, and is difficult to obtain. A small error in the value of n introduces a large error in the calculation.

It is, therefore, preferable to record the co-ordinates of two points of the curve instead of the equation.

New Oil Area in Colombia

Colombian engineers and geologists are investigating a reported new oil area in the southeastern part of Colombia and about thirty-five miles from a navigable affluent of the Amazon. Some drilling has already been done, and good results are claimed. So far, no foreign interests are in the field.

The attention of the American and British operators has recently been directed to the Pacific littoral south of Buena Ventura, where excellent oil indications and structure are reported. This formation is supposed to be a continuation of the horizons yielding high-grade oil, exploited in northwestern Peru and developed by shallow native operations at Santa Elena, in Ecuador.

The Union Oil Co. of California has reported that its first well in Mexico proves to be a 42,000-bbl. gusher, according to word received by the local office from Mexico. The well in a twelve-hour day is said to have delivered 20,891 bbl. through a pipe line for three miles and kept the pressure at 350 lb. in the line. Oil men on the ground, according to the report, estimated that if the oil was flowing into tanks that were closer the well would run as high as 80,000 bbl. a day.

NEWS FROM THE OIL FIELDS

Lost Soldier Field, in Wyoming, Shows Promise at Depth

From Our Special Correspondent

The Blair Oil Co. has completed its No. 22 well in the Lost Soldier field, flowing 600 bbl. daily from the fifth sand at 1,375 ft. Four other sands above this fifth sand were penetrated, each showing oil in commercial quantity. After being cased and deepened the flow increased to 1,500 bbl. This hole is of considerable importance, as it shows that the Lost Soldier field is of much greater importance at depth than was formerly believed.

Several wells have been brought in near Casper recently. The Iowa-Wyoming Oil Co. completed its No. 3 well in the Bolton Creek field, producing several hundred barrels of oil daily. The other wells are being drilled, and the location for a fourth has been made. The Chappell Oil Co. is also spudding in on land of the Victor-Wyoming Oil Co. In the Osage field a gusher was brought in at 1,320 ft. on land in which the Casper-Osage Oil Co. holds a one-half lease interest.

Considerable work is under way on the Mahoney dome, north of Rawlins. The Utah Refining Co. has struck a good oil showing at 2,100 ft. This has been cased off and the well deepened to the lower sand at about 2,400 ft.

The Midwest Refining Co. is drilling its first well in the Elk Basin field on Section 19-58-99. This well will be drilled to 2,500 ft. at least. Wells producing 50 bbl. daily have been brought in at 1,600 ft. in this field.

The Anglo-United Oil Co., Ltd., has a well 130 ft. deep to the top of a 50-ft. sand in the Dallas field, Lander County, producing about 50 bbl. of heavy oil daily. This is one of the shallowest wells in Wyoming. In contrast to this well oil has been struck in the General Petroleum Co.'s well on Sect. 17, Ferris field, 4,400 ft. deep. Two sands were passed through, but these gave no indication of being oil-bearing until drilling was stopped to permit casing to be set when the hole started to cave at the bottom.

Considerable drilling is being done on wildcat wells in the Muskrat field, thirty miles south of Shoshoni. It is stated that the Midwest Refining Co. has found a good showing of oil and gas at 1,380 ft. in this section.

Deep drilling in the Alkali Butte field, near Riverton, is being done by the Inland Oil & Refining Co. Its No. 2 well is over 2,780 ft. deep, and the first Wall Creek sand, it is expected, will be struck soon. The Cheno-Myrin-Midwest Companies' well in the northern part of the field is down 900 ft. This will also be a deep test. The Myrin Oil Co. will drill twenty wells to the proved shallow sand of this field. These wells will be on property of the Cheno Oil Co. recently taken over on a working basis by the Myrin Co. There are already eight producing wells on this land. The Carter Oil Co. will extract casinghead gas from its gas well, which came in making 35,000,000 ft. of wet gas.

High-Grade Well Rekindles Oil Interest in Montana

From Our Special Correspondent

Cleaning of a shale cave-in at the Frantz No. 2 well in the Cat Creek field, in Fergus County, in the central part of Montana, resulted in the well blowing itself in with a production of 1,200 bbl. of high-grade oil daily. This output at one time showed a flush of 1,800 bbl. The oil runs as high as 50 per cent gasoline, and, for the volume of high-grade flow, the well, it is claimed, will stand alone in the country. Up to the time the well had been cleaned it had an output of about 350 bbl. A pipe line has been constructed from the well to Winnet, about fourteen miles distant, on a branch line of the Chicago, Milwaukee & St. Paul Ry., capable of carrying about 1,200 bbl. daily. This well has kindled anew the oil excitement in Montana, and about 100 drilling rigs are in operation throughout the state.

Oil Struck Within Arctic Circle

From Our Special Correspondent

The Imperial Oil Co. makes the announcement that after two years' exploration and drilling, oil has been struck at Fort Norman, just within the Arctic Circle, north of Great Slave Lake and close to the Mackenzie River. Oil was found at a depth of 480 ft. with a flow of 10 bbl. per day. The company has eleven rigs operating at various points in Western Canada, carrying out the program as announced at the annual meeting last February, comprising the exploration of all prospective oil areas in the country.

Few people appreciate the immensity of this undertaking. Fort Norman is 1,000 miles north of the nearest railway, and the complete drilling outfit had to be taken by water down the Peace and Slave Rivers, through Great Slave Lake and down the Mackenzie River. Fur traders in those far posts receive mail only once a year. The crew and outfit started down the river early in the summer of 1919, but on account of low water had to winter at Great Slave Lake, the journey being completed this year.

At Czar, Alberta, where one well is already 2,000 ft. down, it is thought the prospects of striking oil between that point and 2,500 ft. are good.

1,000-bbl. Gusher in Kentucky Kills the Driller

From Our Special Correspondent

A gusher which flowed 250 bbl. the first four hours was brought in Aug. 18 on the S. A. Kelly farm near Bowling Green, Warren County, Ky. It was completed at 484 ft. and is estimated good for 1,000 bbl. a day. Fred Fulton, sixty years old, driller, was burned to death when the well came in. Other drillers succumbed temporarily to the gas fumes from the well.

A well was completed Aug. 20 on the farm of General W. L. Sibert, offsetting the Tarrants wells near Bowling Green. Oil was thrown 60 ft. into the air and a continuous stream shot skyward for forty-five minutes before it was put under control. The initial flow was 100 bbl. an hour.

The Leon Producing Co. recently brought in a 500-bbl. well on the Davenport lease in Warren County. The well was standing 700 feet in oil when it was shot. Location is being staked out for No. 2, on which work will begin as soon as No. 1 is put on the pump.

Interest in oil is growing in Cumberland County, eastern Kentucky. The Southern Oil & Refining Co. brought in what is described as a "real good well" on the Russ Gilbert farm, near Bakerton. A strong stream has been flowing from the well to the Cumberland River, a half mile distant. It is located a short distance from the "Old English" well, drilled in 1866, and which produced 1,200 bbl. daily. No. 2 of the Carter Oil Co. is reported from Menifee County on the John Powers lease, rated at 100 bbl. Oil operators report this to be a promising field. The Turtle Oil & Gas Co. is drilling south of Paintsville, Harlan County, and expects to be in the sand soon.

Colorado Wildcat Strikes Oil

From Our Special Correspondent

It is reported that the Nee-No-She Oil Co. has struck oil at 2,550 ft. in its well in Sect. 18, T.20S., R.46W. in Kiowa County, Col. The well has not yet been bailed, so it is impossible to state what its possible production will be. Naturally, the discovery of oil in a wildcat well of this character has created great excitement locally, and leases are selling at high figures.

The Producers & Refiners Corporation has secured leases on a block of 8,000 acres in Routt County. This area covers, it is believed, two possible oil-bearing structures. The first well will be drilled near the center of the southeast one-quarter of Sect. 25-4-88. Machinery and building material are being hauled in from Hayden, the nearest railway station, about twenty miles southwest. Several years ago gas was found at shallow depth in this section.

COURT DECISIONS IN MINING CASES

By Wellington Gustin

Deister Machine Co. Patents Held Valid

U. S. Circuit Court of Appeals Rules Claim Not Void, Though Not Included in Co-pending Application

The Circuit Court of Appeals of the United States, Seventh Circuit, recently affirmed the judgment of the District Court holding the patent of the Deister Machine Co. for improvements in concentrator tables valid and infringed by the Deister Concentrator Co. In the appeal the Concentrator company attacked the decree of the District Court upholding certain claims in three patents covering improvements in concentrating tables, asserting that all the patents were invalid and that its structures do not infringe any of the claims involved. It also claimed that as to the first two patents issued there had been double patenting.

Speaking for the court, Judge Evans says that various types of concentrating tables were well known to the trade in 1912. Some were covered by patents, and certain factors in the successful operation of all concentrating tables were well recognized at that date. Among the well-known types were the Gilpin County bumping table, the Gold Coast of Africa table, the Overstrom table, and the Butchart bent-riffle table. From these types, as well as from various patents, it was found that riffles were old, resistance planes were old, and the reciprocal longitudinal movement and the tipping or tilting of the table were all well known, and had been commonly practiced for many years prior to the appearance of the Deister Machine Co.'s tables.

The inventors of this company's table were far from being pioneers in the art. However, they conceived and worked out what they claimed was an improvement over other tables. A new element was added to these older ones, which, co-operating with them, doubled, it was claimed, the capacity of the table, without increasing the loss in the tailings, secured a cleaner and greater quantity of ore values, and reduced the item of labor cost. The court found some evidence to support these assertions. That an increased capacity without loss in the tailings resulted was not seriously disputed.

The Machine company's Claim 4 of Patent 1,040,164, for concentrating table, one element of which is a plateau having its surface above, but substantially parallel with, the general surface of the table, and Claim 1 of Patent 1,040,165, having the same element, were held valid and infringed, though the plateau of the Concentrator company's table was not precisely parallel with the surface of the table.

Defining the terms "substantially parallel," the court says the patentee was seeking apparently to prevent congestion of material on the dam or incline connecting the plateau with the main surface of the table. If the plateau was approximately parallel, the material leaving the apex of the dam or incline would move more rapidly than it traveled while ascending the incline, with the result that the minerals would spread out and the wash water would remove the slime or sand that was carried up the incline by the values. Thus, "substantially parallel" as used here is a relative term, and not synonymous with exactly or precisely parallel. And defendant's plateau was sufficiently parallel, said the court, to constitute infringement of the patent.

Applications by the same person for the two above-numbered patents were co-pending in the U. S. Patent Office, and the patents were issued on the same day. The defendant contended the claim of the latter was void because it was only a broader or more generic claim and might have been joined with the claims of the first patent. The court ruled against the contention that there had been a double patenting, and said it could not be assumed that the issuance of the one with the smaller number preceded the issuance of the other.

Claims 1, 4 and 5 of the Deister patent, No. 1,088,685, for a concentrating table having a plurality of plateaus, with the front edge of the final plateau forming the mineral-discharge edge, were held valid and infringed, though defendant's final plateau was rounded near the edge. But, the patentee having specified as one element of his combination a plurality of plateaus, with the front edge of the final plateau forming the mineral-discharge edge, he was limited to a table in which the front edge of the final plateau formed the mineral-discharge edge, though such element was valueless.

Thomas Et Al Guilty of Contempt in South Butte Suit

In the contempt proceedings of the South Butte Mining Co. against Thomas B. Thomas, in which the Circuit Court of Appeals, Ninth Circuit, held Thomas and others in contempt for attempting to obtain a patent from the Land Department to the Resurrection lode claim, the Supreme Court of the United States has denied the petition of Thomas for a writ of certiorari to the Court of Appeals, making the judgment of that court conclusive in holding them in contempt.

Arizona Supreme Court Defines Private Nuisance Law

Rules as to Conditions Under Which Mines Are Liable for Noise, Smoke, and Offensive Odors

Judgment against the Arizona Hercules Copper Company, in its condemnation proceedings against the Methodist Church at Ray, and the Ray Consolidated Mining Company, has been affirmed in the Supreme Court of Arizona.

In its opinion the court says that a mine had the right to construct ore bins at the mouth of its shaft on its own property, and the fact that they were in close proximity to a church, and that in their reasonable use the noise therefrom disturbed public worship or other functions of the church, and thereby diminished the value of the church's property, gave the church no right of action for damages.

And where a mine condemns property and lays tracks for its private use, the principles applied to common carriers when acting in their private capacity should be adapted in fixing the liability of the mine owner for damages to private property.

Further, a mine which condemns a small strip of land for a track and in the general plan of construction intends to construct several other tracks on a highway, tracks being for the private use of the mine, the rule of consequential damages should be extended to all the tracks and their operation, and the land owner is entitled to damages by reason of noise, smoke, cinders, vibration, or other nuisance or injury; the improvements amounting to a private nuisance under the Arizona law.

Judgment Against Brant Independent Mining Co. Reversed

In another action arising out of the foreclosure proceedings against the Brant Independent Mining Co., the U. S. Circuit Court of Appeals has again reversed the judgment of the District Court for Colorado, which had awarded to the trustee in the mortgage a deficiency judgment in the sum of $108,373 against the mining company.

The judgment was the difference between the amount found due upon the bonds issued by the mining company, with interest and costs, less the amount received from the sale of the mortgage property. The Court of Appeals ruled that a trustee in a corporation mortgage securing bonds, on foreclosure of the mortgage, is not entitled as such trustee to recover a deficiency judgment for the amount found due on the bonds over and above the proceeds of the sale, unless such right is given him by the mortgage.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Bisbee To Remain American, If Possible, Says Dowell

Large Number of Mexicans on Sacramento Hill a Temporary Condition —Operations Must Continue

"Present Plans and Plans for the Future in Company Operation," was the subject of a recent talk at Bisbee, Ariz., by G. H. Dowell, manager of the Copper Queen branch of the Phelps Dodge Corporation. Mr. Dowell made the first authoritative remarks that have been heard there in some time, as to the views of the company on the labor situation and the prospect for the future in the matter of ore reserves. He said in part:

"The company that I represent depends largely on the income from this property for the development of other properties. As you all know, operations have been restricted during the last year or so on account of the inability of the company to market copper, but all look forward to a time when we shall be able to market all the copper we can produce.

"In addition to normal mining operations, there has been the work on Sacramento Hill. The company has invested there already about $5,000,000 and before the project is ready for operation will have invested more than $8,000,000. I remember that a speaker here some time ago remarked that Sacramento Hill is an illustration of the saying that faith will move mountains, but I have found that it takes something more than faith to move Sacramento Hill. The project is really just begun. We have moved, up to date, about 10,000,000 tons, but before the project is completed shall have to move more than 80,000,000 tons.

"The companies and the community here, as elsewhere, have the problem of labor supply. We have had and have now all the labor we need under present production conditions. I think we shall have enough when the time comes to attain our normal output of about eight millions pounds of copper a month.

"It has been the policy of the company to employ English-speaking men under ground. About 80 per cent of those now working under ground are Americans. I hope the company may be able to continue this policy. On Sacramento Hill the company has been forced to employ much Mexican labor, but you should understand that this is only a temporary condition. When the Sacramento Hill project has been completed, most of these will be laid off.

"The problem of obtaining American labor devolves on three conditions. The wage scale is the first. This camp has the reputation of paying as high or higher than other places. The company desires to maintain this reputation. To a certain extent, however, the company's hands are tied. It would be destructive to depart very far from the scale of wages paid for similar labor in other camps.

"The second point in obtaining American labor is the treatment of men on the job. We are trying to bring about a system whereby a man gets a square deal on the job. Under such conditions men become and continue contented, and will want to stay.

"The third point is community environment. There is no other locality in the Southwest that can compare with Bisbee in climate and public schools. We have done what we can in the matter of providing recreation. Men who are working hard must have recreation. We have endeavored to assist in the matter of housing. It has been the policy of the company to employ married men and to enable them to provide a home. We have encouraged home building, but in the last few years have been hampered by the war and high costs in this respect. Many employees provide their own homes through the Building and Loan Association. Married men, as a rule, are the most dependable and efficient and lose less time on the job.

"Another matter of importance is that of community spirit. Men who come into this camp must be made to feel that they are one of us. It makes no difference what occupation a man is in if he is an honest man earning an honest living.

"We hope to maintain our policy of employing Americans in this camp. It would be disastrous to have to shut down the mines in order to carry out this policy, and if the worst came to the worst we would employ what men we could get. This is a matter in which all are vitally interested. The company will carry out the policy of employing Americans to the fullest extent, but we need your assistance.

"With regard to the future of Bisbee, we have as much ore reserves now as we ever had. A large part of the earnings of this property will be put back into it."

The Société de Chrome has been having some difficulty in completing the installation on Yaté of the extensive hydro-metallurgical installations ordered from France. The local canaques, by advice of their religious leaders, are refusing to recognize the validity of sales of land regularly agreed on and ratified by current usage and decrees. The colonial government has been hesitating in face of the native opposition. writes *Le Bulletin du Commerce* of Nouméa, and work has been held up.

Stolen Platinum Recovered by Aid of Bureau of Standards

One of the noteworthy features in the industrial chemist's year of 1919-1920 has been the theft and subsequent recovery of large quantities of platinum laboratory utensils belonging to government and private laboratories. Two men were arrested last April while attempting to dispose of 280 troy ounces of platinum "sponge," the porous state of the metal. They had left small lots with two firms who, having circulars concerning various thefts, notified the authorities.

A general round-up was ordered and inventories of all Government platinum in various bureaus and in munitions manufacture were made.

Chemical analysis indicated that the seized supply had come neither from the New Jersey plant nor from the laboratory of the Bureau of Standards. The Government agents did not believe the story of one of the men that he and a friend had obtained the metal by placer mining about 100 miles north of Parry Sound, Ont., because there had never been any of the metal found there.

In its quality the captured consignment closely resembled the stocks at the War Department Plant at Nitro, W. Va., where the inventory showed there should be 5,000 ounces of sponge, and also the stock at a Government military plant at Jacksonville, Tenn. As some of the platinum at Nitro was known to contain a large percentage of palladium that in the satchel seemed to have come from Jacksonville.

One of the men, although he said that he was a Canadian, spoke with a marked Southern drawl, which suggested that he had been born not far from the Blue Ridge. He had a certain indolence of manner, which made the detectives think he would not work his imagination any more than he was compelled to do. Finally they located a Maxwell House in Nashville, Tenn. Government agents immediately were dispatched to this hotel and working from it discovered that one of the men arrested had been employed in the Old Hickory Powder Plant at Jacksonville. The investigation led from the powder plant to the Government reservation and resulted in the arrest of an assistant chemist who was implicated in a confession as the man who had abstracted the precious metal.

According to the chemical society's account, investigation disclosed that the chemist had abstracted the platinum sponge and in its place put mercury and ordinary moist dirt. The Government agents declared that the plan was to steal eighty-six cans, each containing twenty-five ounces of platinum, selling the metal for $100 an ounce.

Book Reviews

The Iron Ores of Lake Superior. By Crowell & Murray. Cloth; 6¼ x 9¼; pp. 302; maps; Penton Publishing Co., Cleveland, Ohio.

This fourth edition includes revised and up-to-date information concerning the iron mines and ores of the Lake Superior district. Supplementing the data covered in the earlier editions, a chapter describing modern methods for mixing ores and figures showing average analyses and shipments since 1917 have been added. The book serves not only as a valuable reference work to the operators in that section but as a guide to the student of iron ore mining, as all of the chapters, with the exception of 9, 11, and 12, relate to some phase of mining or marketing iron ores. The arrangement of the data is such as to afford an excellent conception of the manner in which operations are carried on, and although a further elaboration on the subject of mining methods might be given, it is questionable if such is warranted in the preparation of a book that fulfils in such a complete manner the demand for information regarding operating mines.

Mining Directory of Minnesota for 1920. Compiled by the Minnesota School of Mines Experiment Station. Paper, 3½ x 6, pp. 153. Published by the University of Minnesota, Minneapolis, Minn.

Part I contains thirteen maps reproduced from the originals, prepared by the Mines Experiment Station. These show a general map of the iron ranges and separate maps of the Mesabi, Vermilion and Cuyuna ranges. Part II contains a list of all mines and properties that have shipped ore or are listed on the tax records as containing taxable ore. The name, location, and legal description of each are given. Part III includes a list of the various companies, together with the names of the officials, subsidiary companies and the properties with which they are associated. Part IV contains a list of the men associated with the mining industry of the state.

The compilation is issued in a most convenient form and will be found valuable to those in any way connected with the iron industry. Much of the excellent work of data collection which has been done in this section must be credited to the Experiment Station of the Minnesota School of Mines.

Earthwork and Its Cost. By Halbert Powers Gillette. Flexible binding, 4¾ x 7; illustrated; pp. 1350. McGraw-Hill Book Co., New York. Price $6.

The author of the book is too well known to need introduction to engineers, and the same thoroughness which has characterized his earlier works is noticeable in this handbook of earth excavation. In his preface and introduction, Mr. Gillette emphasizes the value to the engineer of the careful collecting and analyzing of cost data. The subsequent chapters of the book are proof sufficient that his contentions are well taken, for the data relating to each object leave little to be desired. Among the subjects covered are the following: Properties of earth; measurement, classification and cost estimating; boring and sounding; clearing and grubbing; loosening and shoveling earth; spreading, trimming, and rolling earth; haulage and earth removal and excavation, and the design and construction of embankments, earth dams, and similar works.

Technical Papers

Flotation in Australia—"Some Controlling Factors in Flotation," by Ralph D. Nevett, with subsequent discussion, occupies seventeen pages in the March *Proceedings* of the Australasian Institute of Mining and Metallurgy (Melbourne). The paper discusses the principal things which must be watched to secure satisfactory results in Australian selective flotation practice. 1. *Crushing.* The ideal feed is slime. 2. *Rate and Regularity of Feed.* It is absolutely necessary to have a regular flow of feed for the best results. A large storage tank should be provided, as an agitator or Dorr thickener. 3. *Density of Pulp* This is very important, and it is necessary to find what density will give the largest capacity and best metallurgical results; that density must be kept constant by frequent tests. 4. *Temperature.* The temperature must be watched closely, both in the SO_2 and the Palmer-Seale-Nevett processes. A difference of two or three deg. F. may have a marked effect. Some external heat is usually necessary: introduction of high-pressure steam into the pulp is the favorite method. 5. *Addition Agents.* These should be added generally as far ahead of the flotation machine as possible. 6. *Condition of Circuit Liquor.* The water must be clean. Other requirements are indefinite. A certain quantity of salts in solution seems to improve the results. The addition of elemental sulphur seems often to be beneficial in the P.-S.-N. process. Oil must be emulsified. 7. *Agitation.* "Agitation is beneficial in all methods of flotation of all classes of ore." An agitator ahead of the flotation machine is recommended. Sometimes bucket elevators provide sufficient agitation. 8. *Aëration.* Air must be admitted in minute bubbles only, and under the agitating impellers. In the discussion following the reading of the paper Mr. Henderson said soluble salts could be present up to 8,000 gr. per imperial gallon. He was against the use of compressed air in any form. Mr. Nevett replied that compressed air increased capacity when treating slime. Mr. Chomley said primary slime (colloids) had a bad effect. Regularity of flow was very important, and underflow from a Dorr thickener was not as satisfactory as material from an agitating tank for this purpose. Mr. Read said he had no trouble using compressed air as long as it was properly atomized. A density of 45 per cent was found much better than one of 50 per cent in one instance. Mr. Wincey said best results were obtained on slime and that troubles from that source were probably due to dirty circuit water. Large amounts of salts in solution caused no trouble provided the SO_2 process was used.

Bolshevik Russia—Two very informative articles written in a most interesting manner are "Actualities in Industrial Russia of Today," in the August number of the *Compressed Air Magazine* (11 Broadway, New York City, 25c.) and "Bolshevism From the Inside," in the August *Atlantic Monthly* (Boston 9, Mass., 40c.). Is is plain that Russia is no place for a white man; it is a proper territory only for Reds.

Chrome—*The Colorado School of Mines Magazine* for July (Golden, Col., 25c.) publishes a seven-page article on the concentration of a Montana chrome ore, a "black sand" from Oregon, and a slag resulting from the production of ferrochromium in the electric furnace.

Chloride, Arizona—The history and prospects of the Chloride district are discussed in the August number of the *Arizona Mining Journal* (price 20c., Phœnix, Ariz.). Special mention is made of the Chloride Queen, the Dardanelles, the Molly Gibson-Chloride, and the Tuckahoe properties. The author admits that the district is dead, but thinks that modern metallurgy will solve the complex ore problem there if capable management and sane financing can be obtained.

Talc and Soapstone—In *Reports of Investigations* for July, Serial No. 2,142 (Department of the Interior, Washington, D. C.), R. B. Ladoo discusses talc and soapstone (five pages). The common physical and chemical tests which determine the grade of product are outlined and a plea is made for standardization so that definite and comparable price schedules can be formulated.

Federated Engineering Societies—Those of our readers who wish to know all about the organization and purpose of the Federated American Engineering Societies will be interested in a pamphlet entitled "Engineers Unite," which may be obtained free of charge from the McGraw-Hill Co., New York. It consists of reprints of news articles and editorials from the pages of the publications of the societies and the engineering and industrial journals.

Barite—"Barite Deposits in Upper East Tennessee" is the title of a six-page paper in Bulletin 23 of the Tennessee State Geological Survey (Nashville, Tenn.). Short references to known deposits are made.

MEN YOU SHOULD KNOW ABOUT

J. Leonard Replogle returned to the United States from Europe on Aug. 21.

W. E. Malm, of the Malm-Wolf Co., is in New York City on professional business.

J. Parke Channing, of New York, recently spent two weeks in the Michigan iron and copper fields.

M. H. Alworth, owner of several Mesabi Range operations, has completed an inspection of his properties.

Bailey Willis is working out the geology of the Washington magnesite deposits for the Northwest Magnesite Co.

Walter Harvey Weed has completed and reported on his examination of the Boston Montana Development Co. property.

Sir John Cadman, professor of mining at the University of Birmingham, England, recently resigned from that chair.

Roy J. Colony, instructor in geology in Columbia University, New York, is examining gold properties on Long Lake, Manitoba.

Eugene Dawson, mining engineer, will sail for South America on Sept. 7. He will examine mining properties in Brazil and Bolivia.

E. E. Hunter, general manager of the Hanna Ore Mining Co., has returned to Duluth, Minn., after a business trip to Cleveland, Ohio.

R. M. Overbeck, of the U. S. Geological Survey, has returned from a trip to South America where he has been on petroleum work.

A. K. Knickerbocker, superintendent for the Northern Minnesota Ore Co., is in charge of manganese operations for his company at Cushman, Ark.

F. A. Vestal, superintendent of the Bureau of Mines helium plant at Petrolia, Tex., has been paying a visit to the Washington offices of the bureau.

William H. Hubbard, Jr., of the Northport Smelting & Refining Co., is spending a few months at the affiliated works of the Pennsylvania Smelting Co., Pittsburgh, Pa.

Dwight E. Woodbridge and **George H. Rupp**, mining engineers, have completed a trip into the Hudson Bay country.

Lewis A. Levensaler, consulting mining engineer, 902 Hoge Building, Seattle, Wash., has gone to Nome and other Seward Peninsula points on examination work and will not return before October.

C. D. Young, general supervisor of stores, Pennsylvania R.R. system, Broad St. Station, Philadelphia, Pa., and vice-president of the American Society for Testing Materials, has been appointed as representative of that society on Engineering Council.

John D. Ryan, chairman of the board of directors of Anaconda Copper Mining Co., was in Butte recently inspecting the mining properties of his company and in conference with C. F. Kelley, president of the corporation.

J. Henderson, an English oil expert who was at Baku for a number of years looking after British oil interests, is in Canada on behalf of the Anglo-Persian Oil Co., which has secured oil leases in the neighborhood of Moncton, N. B.

E. J. Maney, general manager of the ore mines of the Shenango Furnace Co., has returned from a lake trip on one of the company's ore boats in company with **W. P. Snyder**, president, and **C. D. Dyer**, vice-president, of the company.

Harris & Ewing

ARTHUR E. WELLS

Arthur E. Wells, formerly assistant chief metallurgist and assistant supervisor of stations at the Salt Lake City station, has been made chief metallurgical engineer in charge of the new non-ferrous metallurgical division of the U. S. Bureau of Mines. Mr. Wells' headquarters will continue to be at Salt Lake City, Utah. He has been a member of A. I. M. E. since 1916.

D. D. Irvin, of Douglas, Ariz., has been appointed general superintendent of Moctezuma Copper Co. (the Phelps Dodge subsidiary) with headquarters at Nacozari, Sonora, Mex., where **H. T. Hamilton** continues as general manager.

Charles Camsell, who is leaving Vancouver to take up the duties of Deputy Minister of Mines at Ottawa, was given a farewell banquet on Aug. 18 by the British Columbia division of the Canadian Institute of Mining and Metallurgy.

Capt. M. L. Fay, one of the pioneer prospectors of the Lake Superior iron country, and who has for several years been on the Mesabi and Cuyuna ranges, has returned to the scenes of his earlier work on the Gogebic range to study the more recent developments of geologic interest.

OBITUARY

Clyde M. Ney, a mining engineer thirty years old, employed at the Old Dominion mine, Miami, Ariz., was instantly killed on Aug. 2, last, by a blast on the mine's eighteenth level.

Jared Everett Gaylord, formerly manager of the Parrot Silver & Copper Co., a prominent copper producer of Butte, Mont., died at the age of seventy-six, in Bridgeport, Conn., on July 22 last. Mr. Gaylord was born at Liberty, Sullivan County, N. Y., Jan. 14, 1844, and went to Butte, Mont., in 1882, where he remained until his return in 1898. He took an active part in all that related to the development of Utah.

J. C. Gwillim, professor of mining in Queen's University, Kingston, Ont., from 1903 to 1919, died on Aug. 19 after a long illness in his fifty-second year. He was a graduate in mining engineering of McGill University. Professor Gwillim spent several summers exploring coal lands and oil properties of the Canadian Pacific Ry. In 1919 he explored the Peace River oil fields for the British Columbia government.

SOCIETY MEETINGS ANNOUNCED

Iron & Steel Institute, 28 Victoria St., London, S.W.1, will hold its fall meeting at Cardiff, Wales, on Sept. 21-24 next, in the rooms of the South Wales Institute of Engineers. G. C. Lloyd, secretary, is at the above address.

A First-Aid and Mine-Rescue Contest will be held Sept. 9, 10, and 11, in Denver, under the auspices of the U. S. Bureau of Mines in co-operation with the Rocky Mountain Coal Mining Institute, Colorado Metal Mining Association, and the Colorado Chapter of American Mining Congress, which will hold meetings in Denver on the dates mentioned.

The Sixth National Exposition of Chemical Industries at Grand Central Palace, New York City, Sept. 20-25, has just issued its revised official program. Among the cinema displays at 8 p.m. of particular interest to our readers are noted:

Sept. 21, (1) "The Story of Sulphuric Acid," one reel.

Sept. 23. (1) "Modern Coke and Gas Manufacture," three reels.
(2) "Story of Petroleum Oil," three reels.

Sept. 24. (2) "Building, Mining and Quarrying Machinery," two reels.
(4) "Silver Mining," and (5) Gold Mining in Ontario," one reel each.

Sept 25. (1) "Manufacture of Asbestos," one reel.

THE MINING NEWS

LEADING EVENTS

WEEKLY RÉSUMÉ

Little of the spectacular has occurred recently: Calumet & Hecla has shut down three of its smaller subsidiaries. Lake ore carriers are to be allowed to raise their rates. An ore boat was sunk by collision on Lake Superior. The village of Kinney, Minn., has been awarded the decision in its case with the Cleveland-Cliffs Iron Co. In Missouri the St. Joseph Lead Co., in line with its practice in the past, has announced another stock dividend. In the Joplin district, a new boom is looked for in the section near the old Badger-Peacock camp, 12 miles away. In the Coeur d'Alenes, it has been announced that the Pine Creek railroad will be extended 6½ miles, thus benefiting several operators. The New Mexico Mining Association was recently organized.

St. Joseph Lead Co. To Resume Paying Stock Dividends

Will Cut Another Melon After Lapse of Several Years, Continuing Former Practice

After a hiatus of several years, the St. Joseph Lead Co. has decided to resume paying stock dividends. A 10-per cent stock dividend will be paid Sept. 20 on the 1,464,798 shares of outstanding stock. The authorized capital is 2,000,000 shares of $10 each, or $20,000,000 capital in gross, of which 535,202 shares are in the treasury. When the company was incorporated in 1864, the capital was $1,000,000 which was mainly issued to pay for about 900 acres of land and promotion expenses. The capital was increased in 1886 to $1,500,000 to take over the original Desloge Lead Co.'s lands at Bonne Terre in exchange for stock. The Doe Run Lead Co. was also absorbed in 1916 by an exchange of stock. Otherwise the present outstanding stock represents stock dividends that have been paid from time to time.

It was these occasional melons that for years kept the stock in the St. Louis market at such high prices that it only yielded 4 to 5 per cent on the market price and was the highest priced mining stock in the country. Up to 1912 the annual cash dividend rate for the previous twenty-seven years was only 6 per cent, whereas the stock ranged from $12 to $16 per share (par value $10) on the St. Louis market. That these stock dividends were more than justified is shown by the market putting a value of over $20,000,000 on the property, as millions have been put back into the property from earnings in past years.

A quarterly cash dividend of 50c. per share will also be paid on Sept. 9, which will bring the total cash dividends to nearly $22,000,000.

M. B. Dudley Interests Reopening Old Producers in Mohave County, Ariz.

Several Properties, Including C. O. D., I. X. L., Rural, Golden Star and Others, Equipped and Under Development — Many Features Being Worked Out for Group as Whole

BY S. FORD EATON

Activity in mining throughout Mohave County, Ariz., has evidenced a decided rejuvenation during the last few years. New operations are under way, old properties being reopened and mines forced to close down on account of wartime conditions are resuming work. Of the various projects brought into being none is more worthy of note than what is generally called the Dudley interests.

M. B. Dudley, a pioneer of Goldfield, Tonopah and Hilltop, Nev., and eastern associates are the operators and they are furnishing the capital. To Mr. Dudley, however, can rightfully be given credit for the conception, planning and general management of the various operations.

Early in 1917 Mr. Dudley's attention was first attracted to Mohave County in general and the Cerbat Range in particular. At that time he came into this section to examine the old Twins mine in the Cerbat district. With him, as consulting engineer, came W. W. Widdowson. The results of the examination were such that the Twins was purchased outright by the Dudley interests during the latter part of 1917. Since that time considerable development work has been done under the name of the Daisell Mining Co.

During 1918, under the direction of Mr. Widdowson, an extensive program of investigation and examination was carried on in the districts of Cerbat, Mineral Park and Stockton Hill. Early in 1919 four properties were purchased in the Mineral Park District. These were the Golden Star & Queen Bee, Rural & Buckeye, Toledo & Argo (now called Mineral Park Mines), and the Cherum Peak Silver.

In the Stockton Hills section, a three-months examination of the C. O. D. and I. X. L. was made. September, 1919, witnessed the purchase of the C. O. D. and early in 1920 the I. X. L. was taken over under option. Combined holdings aggregate over 100 claims. Separate corporations handle each property but with the exception of the Rural Mines, Inc., they are all more or less interlocking.

The financing of the various enterprises is said to be amply provided for. In a sense, all are closed corporations and there is no stock for sale. To date the preliminary steps represent an outlay of over half a million dollars. Present monthly expenditures are between sixty and seventy thousand.

Inasmuch as the mines are within comparatively short distances of one another and the general management is centralized, numerous features are being worked out with regard to the group as a whole. Active development is being pushed as rapidly as local conditions permit. At present work is going on at the C. O. D., I. X. L., Rural, Golden Star and the Daisell. Each of these is operated as an independent unit under a capable superintendent. F. H. Lerchen is general superintendent in charge of all underground work.

The various properties taken over are mostly mines having recorded production during the past. Practically all of them have produced ore of shipping grade. None of the workings were carried to a very great depth, the former operators having mined only the high-grade surface deposits. In most cases it is the mining and treatment of the large lower-grade bodies which constitute the basis of the present projects.

C. O. D. PROPERTY OF MOST IMPORTANCE

The C. O. D. at present occupies the most prominent position in the group and might be termed the pet of the organization. It is located in the Cerbat Range, seven miles south of Chloride in the Stockton Hill district. Though several other veins show on the property, development and interest center at present in what is known as the C. O. D. vein. This passes through the C. O. D. claim lengthwise with a general strike of N 80 deg. W. Near the middle of the claim the vein, at the surface, is split by an elliptical horse of country rock about 500 ft. long. The workings are on the north spur, which has a dip of 75 deg. N. Indications are that these two spurs converge to the west and join at depth. Croppings to the east of the split are very strong and it is probable that further and deeper development will prove the vein to be extremely wide. Schrader classifies the country rock in the main as porphyritic granite associated with chloritic schist. The gangue is quartz with some talc stringers found in the vein filling. High-grade ore lenses vary in width from 6 in. to 7 ft. with milling ore much wider. The average vein width is problematical as nowhere at a depth

of 300 ft. have the true walls been uncovered. Ore values are in gold, silver, lead and zinc. Recent tests by Mr. Widdowson have proven the existence of an unusual condition; namely, the gold is associated with the lead, the silver with the iron, the zinc being practically free.

On taking over the mine the new management unwatered the No. 2 shaft with the old steam equipment on the ground. As soon as retimbering and lining were completed this shaft was sunk to the 300 level and the long 300 drift cleaned out.

New electrical equipment has been installed. The hoist is a Denver Engineering electric, driven by a 75-hp. motor. It has a ¾-in. cable and is capable of lifting a two-ton live load from a depth of 1,100-ft. A 15 x 9 x 12-in. Ingersoll-Rand compressor, short coupled to a 100-hp. motor, is installed in the same large concrete-floored building. There are also a commodious blacksmith shop equipped with a No. 5 Leyner drill sharpener and punch, timber sheds with crosscut and band saws for framing, change rooms, unit bunk houses, mess house, laboratory and office buildings. The laboratory is completely equipped for ore analysis and testing.

Power is obtained from the Desert Power & Water Co. at Kingman. Tramways and bins are being erected and the old mill near the shaft is being remodeled into a 100-ton pilot mill. Crushing to 1½ in. will be done at the shaft. Three products, lead, iron and zinc, will be made from the C. O. D. ores. The Colorado Iron Works is providing the milling equipment. It is hoped to have this pilot mill running within the next three or four months. There is sufficient material in the old dumps to supply the mill for three months. The mine will then be in shape to supply more ore than is required, and of an excellent milling grade. Mill runs will also be made here with ores from the other mines before any treatment plants are constructed.

Underground work is progressing steadily. The 4½ x 7-ft. development shaft has the same dip as the vein and goes down in the ledge matter. At this writing it is nearing the 400 level. From a 3-ft. lense in the bottom ore running $8 in gold, 37 oz. silver, 5 per cent lead, 6 per cent zinc and 8 per cent iron is being taken out. A hand-sorted test shipment of this ore will be made soon to the smelter. The west drift samples $45 per ton in gold and silver alone over a distance of 219 ft. Ultimate plans call for a large three-compartment shaft east of the present workings. From this shaft the ore will be conveyed by aërial tram to a large mill located on the I. X. L. property.

Geological Conditions Same at I. X. L.

One mile and a half south of the C. O. D. are the I. X. L. claims. A proposed auto road of moderate grade and easy construction will eventually connect the two properties. Geological conditions here are practically the same as at the C. O. D.; the main I. X. L. vein is apparently the southeastern continuation of the C. O. D. vein. In the I. X. L ground this ledge has a more northerly strike and dips about 80 deg. NE. The bend required to bring it into the C. O. D. claim probably has some relation to a cross ledge called the Hyson vein. This vein strikes about N 45 deg. W and was also a surface producer in the old days. It crosses the main C. O. D.-I. X. L. croppings about 1,400 ft. north of the I. X. L. shaft.

The character of the I. X. L. sulphide ores differs somewhat from those of the C. O. D. in that the lead content is much higher and zinc is practically absent. Mill tests on a combination of the two classes have been completely successful.

Early this year the Dudley Interests began work under their option. G. B. Atlee, a former operator, was engaged as superintendent, and the well appointed Wrigley camp, near by, was leased. A 15-hp. gasoline hoist and a two-drill portable gasoline-driven compressor were installed. The old shaft was cleaned out and sunk to a depth of 268 ft. At the 250-ft. level a station was cut and a 28-ft. crosscut driven through the ledge. Here the vein matter proved to be 19 ft. wide. A 200-ft. drift to the south on the vein is under way and will give access to the ground under the old stopes. When I visited the property the face of this drift was carrying a streak of high-grade 12 in. wide at the top and 24 in. wide at the bottom. This ore assayed $2 in gold, 200 oz. silver, 29 per cent lead and no zinc. Drifting north on the vein and deepening of the shaft will be started as soon as new electrical equipment has been installed. The water flow is about 15,000 gal. daily. This is handled by a jack-head plunger pump driven by a 3-hp. gasoline engine.

The possibilities of the I. X. L. ledge as regards milling ore are great. North of the shaft 350 ft. the vein shows in an enormous cropping. Surface trenching indicates a total width of 90 ft. at this point. This entire width is said to average close to $18 per ton in gold and silver. It is on this showing that the future plans for mining and milling are building. In conjunction with the prospective tonnage from the C. O. D. there is available a large amount of good milling ore. The I. X. L. basin offers a number of splendid mill sites and indications are that the two mines will supply ample water. The lower altitude of the I. X. L. ground makes the bringing of the ore from the C. O. D. a simple gravity problem.

Rural-Buckeye Another Old Producer

Less than two miles northwest from the I. X. L. on the southern slope of Cherum Peak are the Rural-Buckeye claims, operated under the name of Rural Mines Co., Inc. The location is in what is called the Mineral Park district, about four miles due southeast from Chloride.

The vein is a fissure in medium-grained granite striking nearly east and west, with a dip of 72 deg. N. Some schist is found associated with the granite. As a rule the walls are hard and require little timbering. Vein stringers shoot off at intervals into the wall rock. The gangue is quartz and has a marked tendency to "freeze" to the country rock. A short distance beyond where the vein leaves the Buckeye claim and enters the Rural (about 250 ft. west of the present main shaft) it is cut at nearly right angles by a granite porphyry dike. This has resulted in a pronounced faulting. West of this fault line there are five parallel vein croppings, so it is to be presumed that one of these is the continuation of the Rural-Buckeye vein. This vein to the east of the fault is remarkable for its persistency and varies in width from 1 to 8 ft. The ore values are in gold and silver; there is considerable arsenical iron, with very little lead and zinc.

New electrical equipment of ample capacity is housed in well constructed buildings. The hoist is a counterpart of that at the C. O. D. A 17 x 19-in. two-stage Ingersoll-Rand compressor driven by a 100-hp. motor supplies air for the jackhammers, Leyners and a No. 3 Cameron pump at the 160-level station. The blacksmith shop has a No. 5 Leyner drill sharpener and punch. The camp in general is well appointed.

A new double-compartment vertical shaft, 4½ x 8½ ft. in the clear, has been sunk in the footwall between the two old shafts. Work is being pushed in a number of faces. A north crosscut west of the fault line is expected to supply information regarding the veins on that side. The long adit is advancing east toward a point where a fourth ore shoot shows at the surface. A raise from the 160-ft. level in an unexplored portion of the Buckeye vein has broken into excellent ore 40 ft. above the level. This ore carries 1 oz. gold and 170 oz. silver.

Golden Star Ore More Refractory

Adjoining the Rural on the south but about 300 ft. lower, is the Golden Star mine, formerly called the Lone Star. The more refractory nature of the ore found in the lower levels apparently was responsible for the cessation of work about 1900. Here the country rock is mostly granite, with some choritic and mica schist. The main fissure is from 2 to 9 ft. wide, striking about west northwest. At the surface it dips 60 deg. S, but at depth flattens to 55 deg. A pronounced tendency to assume a more vertical dip is indicated at the 230 ft. point. Two minor parallel veins come to the surface a short distance south of the main vein. The sulphide ores show considerable arsenopyrite carrying gold, silver and lead. Wire and ruby silver occur in varying quantities.

The first step of the Dudley operations was to clean out the old shaft. At the 100-ft. level a drift was driven in 40 ft. east on a vein seam traced from the old workings. Breaking into the hanging wall uncovered a 24-in. streak of ore carrying 0.8 oz. gold and 17 oz. silver.

While cleaning up and widening the old 185-ft. level to the west the hanging wall was broken into about 100 ft. from the shaft. A high-grade lens 12 in. wide was disclosed in the bottom carrying 9 oz. gold and 240 oz. silver. Both of these finds will be opened up as soon as working conditions permit. Early in 1920 new equipment was installed in concrete-floored buildings. This included a Denver Engineering Co. single-drum hoist with 3,500-lb. rope pull driven by a 75-hp. electric motor, a 12 x 10-in. Ingersoll-Rand compressor with a 150-hp. motor and a No. 5 Leyner drill sharpener. New camp buildings are complete. A vertical two-compartment shaft, 4½ x 8½ ft. in the clear, has been sunk in the hanging wall east of the old shaft. This is now down 200 ft. with a large, well-designed station and an ore pocket at the 160-ft level. Lateral development is in progress.

Daisell a Milling Proposition

Formerly known as the Twins group of five claims, the Daisell in the Cerbat district lies three miles east of the Santa Fe branch line to Chloride and about three-fourths of a mile from the Chloride-Kingman highway. An excellent road has been constructed to the mine. The deposit is essentially a milling proposition. The old incline shaft on the vein was sunk 300 ft. This vein strikes about east and west with a dip of 78 deg. N. The country rock consists of pre-Cambrian granite and schists. The intrusion of a strong trap rock dike striking practically the same as the ledge but with a nearly vertical dip has caused considerable faulting. This is most evident on the 300 level, but the old operators lost the vein at a depth of 130 ft. Recent work has shown that the dike is on the hanging wall of the vein at the 130 level but forms the foot wall at the 300.

The vein varies in width from 6 to 20 ft. The ores are secondary and exceedingly complex, carrying gold, silver, lead, zinc and copper. Three carloads of sorted ore were shipped by the Dudley interests which ran close to $50 per ton. Surface samples along the vein show from 0.75 to 2.5 oz. in gold.

During the last two years much development work has been done with gasoline equipment at the old shaft. An 8 x 10-in. compressor driven by a 40-hp. engine supplies air for the drills. The hoist is a 25-hp. Fairbanks-Morse.

With the old shaft working, a new level was started at the 130 ft. point. This was driven 90 ft. east and 530 ft. west, the latter drift leaving the faulted zone about 250 ft. west of the shaft. The old 300-ft. level to the west was cleaned out, widened and retimbered. During this operation the ore was picked up on the footwall side of the drift. Further work proved the ore to be from 13 to 20 ft. wide.

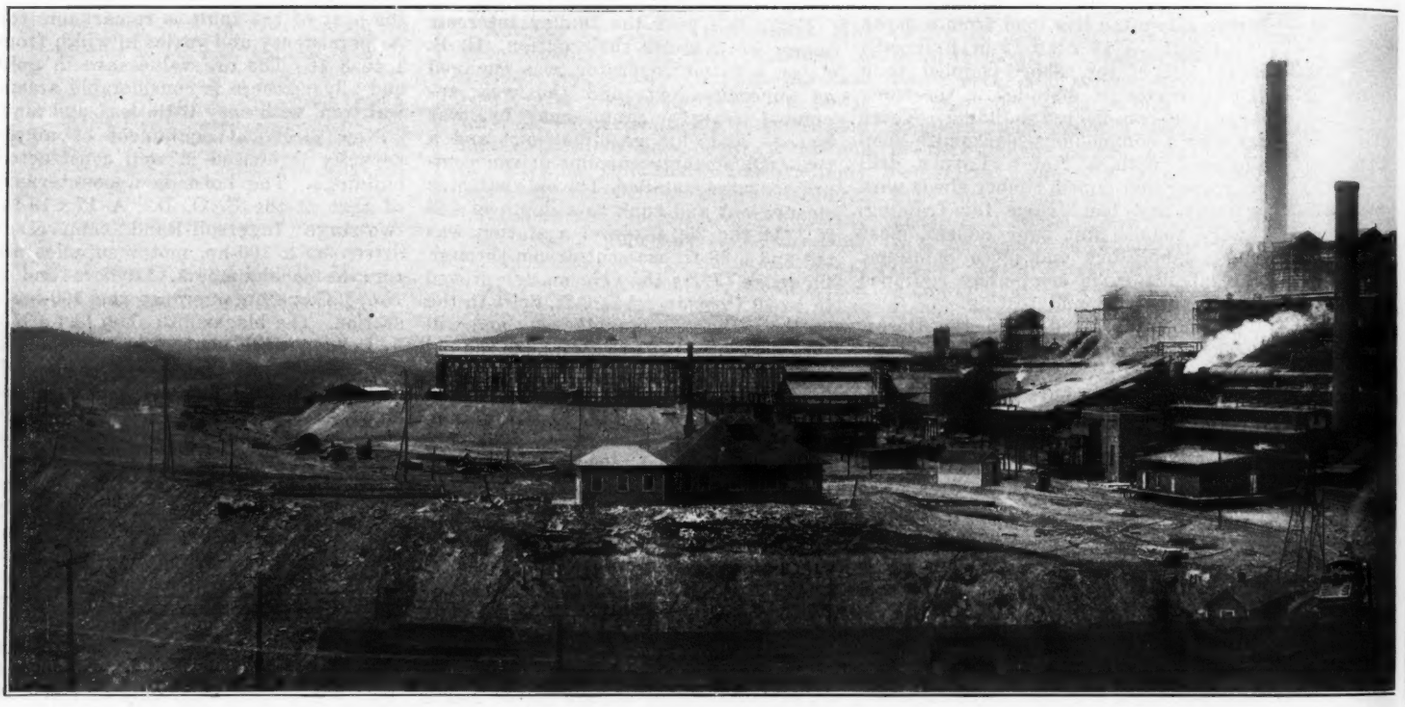
The necessity of a new working shaft and working out of the milling problems have caused work to be suspended for the time being. The management wishes to concentrate efforts on the C. O. D. mill.

Other Dudley properties include the Mineral Park Mines, Inc., holdings which embrace the old Toledo, Argo and twenty surrounding claims northwest of the Rural. Cherum Peak Silver, Inc., lies to the northeast. The latter includes seventeen claims. The high elevation of these claims on the southern slope of the Cherum Peak makes them particularly adaptable to development by adit.

Tennessee Copper Temporarily Leases School Property

Copper Pyrites Corporation Makes Tentative Agreement—Ore Now Going to T. C. Smelter

The Copper Pyrites Corporation, in the Ducktown Basin of Tennessee, has made a temporary lease to the Tennessee Copper Co. subject to two months' notice from either party, of its School Property, the "A" shaft workings of which were illustrated in the Aug. 7 issue of the *Journal*. Tennessee Copper is shipping 75 to 100 tons of ore per day at present over the Copper Pyrites Corporation's tracks and those of the Louisville & Nashville R.R. to the Tennessee company's smelter at Copperhill. The latter company has built a trestle directly from "A" shaft collar out over the Pyrites Corporation's railroad tracks below the shaft and is shipping run-of-mine ore without crushing or sizing other than to grizzly out the fines as the ore runs down the chute leading from the mine-car tipple to the railroad cars. They are thus avoiding the cost of operating the Pyrites Corporation's crushing and sizing plant which was built to prepare ore for use in acid manufacturers' roasters.



SULPHURIC ACID PLANTS NO. 1 AND NO. 2 AND COPPER SMELTER OF TENNESSEE COPPER & CHEMICAL CORPO PLANT IS SEEN ON SUMMIT OF HILL; NO. 2 PLANT IS LONG

Object to Freight Increase on Low-Grade Ores

A protest against a proposed increase in freight rates on low-grade ores is being made by the Utah chapter of the American Mining Congress to the State Public Utilities Commission. The increase has been asked by the railroads in a request for a general blanket raise in rates to conform to the rates authorized by the I. C. C.

New Mexico Mining Association Organized

Step Preliminary To Forming State Chapter of American Mining Congress

Mining men of New Mexico met in Silver City recently and organized the New Mexico Mining Association as a preliminary step to organizing a state chapter of the American Mining Congress. John M. Sully, general manager of the Chino Copper Co., was named chairman of the association and N. C. Cross, Mr. Sully's assistant, was appointed secretary. These two officers were empowered to take the steps necessary to perfect the organization of a chapter of the Mining Congress. Out of a list of fifty representative mining men thirty-three were present.

The executive committee of ten members, including the chairman of the newly formed association, was named, as follows: B. B. Hanger, Albuquerque; Powell Stackhouse, Jr., San Antonio; S. J. Kidder, Mogollon; E. M. Sawyer, Tyrone; Ira L. Wright, Silver City; C. T. Brown, Socorro; J. B. Gilchrist, Fierro; M. W. Porterfield, Silver City, and John M. Sully.

Canada's Deepest Diamond Drill Hole Completed

What is reported to be the deepest diamond drill hole in Canada was recently completed near Chelmsford, Ont., on the Soo branch of the C. P. R. The hole, which attained a depth of 3,007 ft., was put down for W. McVittie, of Sudbury, who was prospecting for coal. A small surface deposit, which certain geologists claimed was anthraxolite, was responsible for the undertaking.

New Boom Expected in Zinc Camp Near Joplin

Recent development in a new field about 12 miles northwest of Joplin, Mo., near the old Badger-Peacock camp, has encouraged mining men to look for a pronounced boom for that section in the months to come. At least two of the larger companies have taken big acreages there. Two new mills are in operation and considerable drilling is under way. One of the new plants is that of the Kanoak Mining Co., of which A. M. Gaines, Picher, Okla., is manager. After a hard fight against water, this plant is turning out a large tonnage of lead ore, which is proving exceptionally rich. The water still prevents the company from going after the zinc run deeper down. Since the successful start of this property, the Huttig Lead & Zince Co. has made contracts for approximately 880 acres one mile immediately north of the Kanoak mine, and in between the two the Chanute Metal Co., a subsidiary of the American Metal Co., has taken a lease. In addition to this, the Chanute company at the present time holds a tract comprising over 1,000 acres.

Mining men of the district believe that this field will prove equally as rich as the new one recently proved up immediately west of Baxter by the Chanute Spelter Co. The Huttig company placed a drill on its acreage in the Badger-Crestline camp on Aug. 26, and will send other drills there at once. The Kanoak company is continuing drilling. The Oakey Mining Co. has completed and placed in operation its new mill immediately east of the Kanoak plant, with highly satisfactory results.

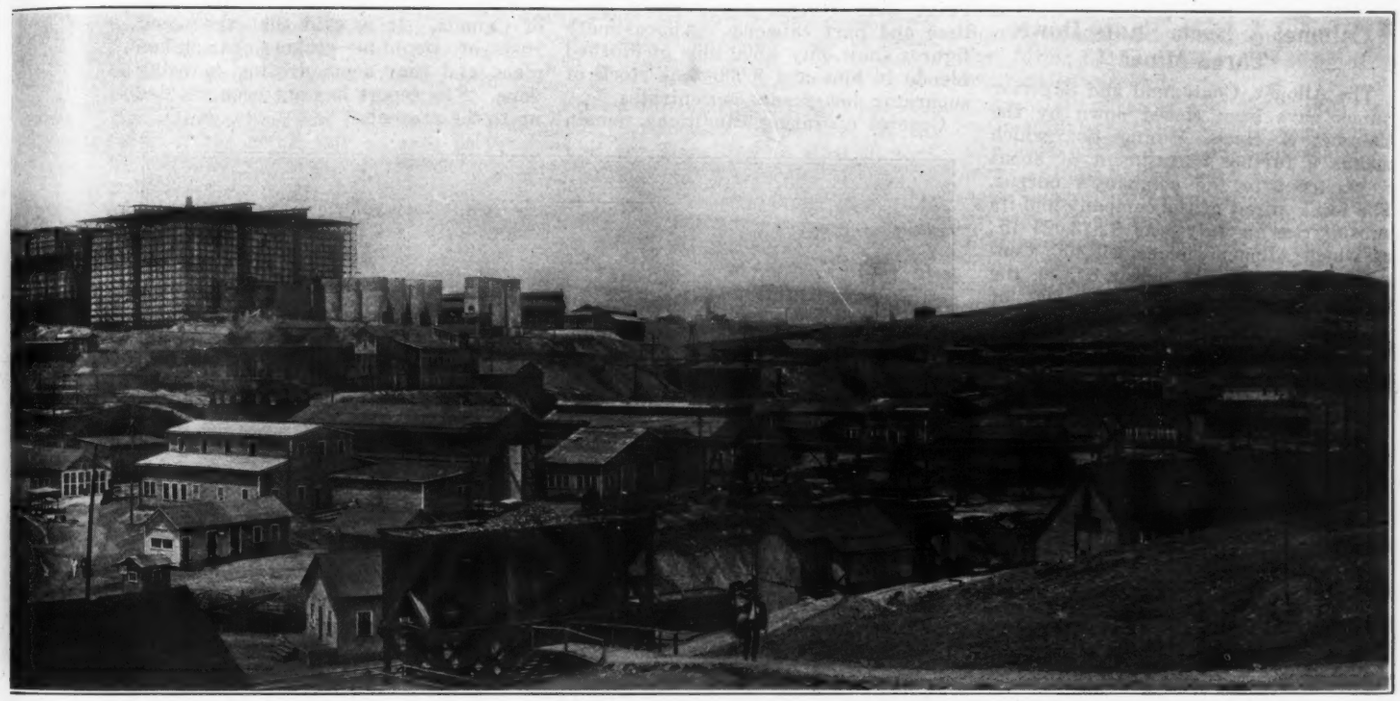
Lake Ore Rates May Go Up

Steamship Companies Privileged To Ask 40 Cents More—Extra Charge To Come Out of Shippers' Profits

Steamship companies operating on the Great Lakes have been given the privilege of raising rates about 40c. per ton from the head of Lake Superior to Lake Erie ports, and it is almost certain that they will take advantage of the offer. New rates can be made immediately, and shippers of iron ore from the Lake Superior district believe that they will have to pay more to have their product transported from Lake Superior to the East. There will be no change in the price of iron ore to offset this extra burden, the iron prices for the year having been fixed. It simply means that the operators will be deprived of a part of their profits.

The ore is now going down the lake at a steady rate, and the August movement will be in excess of 9,000,000 tons. The Oliver Iron Mining Co. is about 2,000,000 short tons short to date, but there is some hope that this will be made up prior to the closing of navigation. Coal is now coming into the district in far greater quantities and there is little fear that the mines will experience a shortage during the winter. The boats are moving more freely and there are not the long delays at lower lake ports which held back the ore and coal movement during the early months of the 1920 season. There is no doubt that the ruling of the Government with regard to delivering coal to the Northwest relieved the anxiety of a lot of mining men of the region.

Ore cars are not so plentiful as they might be, and it is reported that some of the railroads are to add more equip-



RATION, COPPERHILL, TENN. TOTAL CAPACITY OF ACID PLANTS IS 350,000 TONS OF ACID PER YEAR. NO. 1 ACID LOW BUILDING AT LEFT. SMELTER IS IN LEFT CENTER

ment before next year. The old wooden cars are fast disappearing, and steel cars are now more numerous than the others. There is a possibility of the Lake Superior & Ishpeming road being electrified between Ishpeming and Marquette, on the Marquette Range, and engineers have already gone over the system and made estimates. The company has waterpower that can be used, and it is believed that a saving would result. There is a drop of close to 800 ft. in the fifteen-mile haul, and power could be generated and returned to the line during a part of the run. The L. S. & I. hauls most of the ore that is mined on the Marquette Range, being principally an ore road.

Calumet & Hecla Shuts Down Three Mines

The Allouez, Centennial and Superior mines have been closed down by the Calumet & Hecla Mining Co., which means a further curtailment of about 8 per cent in the company's output. The total output of the company and its subsidiaries in July was 8,312,025 lb., of which Allouez yielded 262,400, Centennial 34,600 and Superior 85,890, the output of the three being 382,800, or about 4.6 per cent of the total. It is said that the company intends to shut down the Osceola mine also shortly, the force there having already been reduced.

Cage Falls in German Mine, Killing Twenty-five

On the morning of Aug. 8 the hoisting rope broke at the Kaiserstuhl mine in Germany. The cage fell to the bottom, a distance of 360 m., and twenty-five miners were killed.

Mine Shaft on Rand Collapses

The Robinson shaft of the Randfontein Central Gold Mining Co., Johannesburg, South Africa, is reported, somewhat belatedly, to have collapsed on July 29. It is said that it cannot be repaired and that its loss will affect the tonnage hoisted until the north vertical shaft comes into commission this October. The company hopes to make a small profit in the meantime. The expense of maintaining this shaft has been heavy. It had been intended to abandon it toward the end of the year, when the new shaft should become available.

Lake Ore Carrier Sunk

The steamer "Superior City," of the fleet of the U. S. Steel Corporation, was sunk in Lake Superior in collision with the steamer "Willis L. King," of the Jones & Laughlin fleet, on the night of Aug. 20. Twenty-nine lives were lost. The first boat was bound south with ore and the "King" upbound with a light cargo of coal when the accident occurred off Keweenaw Point. It is reported that the night was clear and fogless and that the accident was due to a misunderstanding of signals. The Federal authorities are now investigating.

Wisconsin Zinc District Output Below 1919 Average

Eighteen Concentrators Active—Operating Conditions Bad

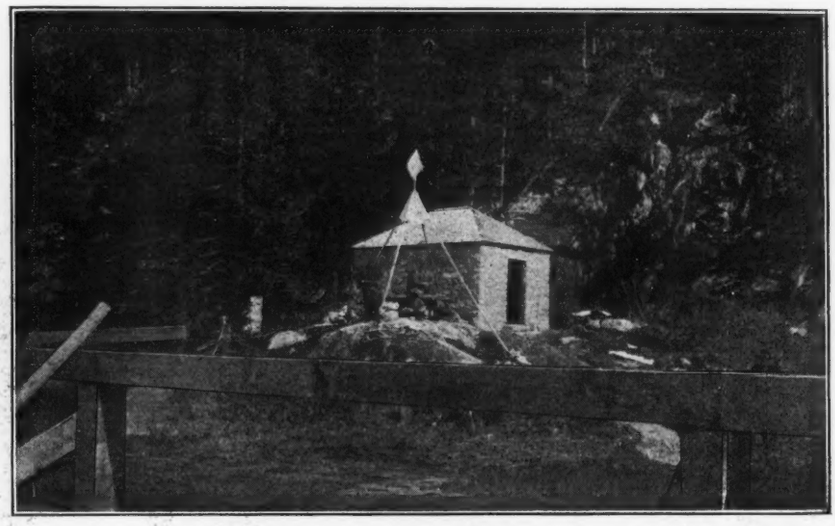
The curtailment of operations in the Wisconsin zinc district has reduced the weekly production of raw blende concentrates to 2,000 tons, which is 33 per cent below the average for 1919. Only eighteen standard concentrating mills are now active, their combined maximum daily capacity for the hours operated approximating 6,000 tons. Only six mills are being run double shift or twenty hours, the rest being run only one shift of ten hours or less. Four roasters, not including the Mineral Point Zinc Works, are running part time and part capacity. Approximate figures show only 4,500 tons of finished blende in bins and 8,000 tons stock of separator low-grade concentrates.

General operating conditions remain bad. Labor is somewhat more plentiful for those continuing to operate. At Highland the Mineral Point Zinc Co. is dismantling its remaining mill. Only one mill, the Lampe, remains intact at this old carbonate-producing camp. Linden's last active producer, the Fearless, has just closed. At Mifflin, the two Cokers of the Mineral Point Zinc Co. and the Yewdall of the Vinegar Hill Zinc Co. have kept going, and the B. M. & B. has just been reopened as the Fearless No. 2.

Platteville camp has one steady producer, the Blockhouse. Cuba City camp has the Big Dick and Connecting Link No. 2. The Connecting Link Co. has its No. 1 mill completed and ready to go. The Zinc Hill Co., owner of the Big Dick, plans to build a 100-ton mill this fall on the Tom Lee lease and to erect a roaster as soon as construction conditions improve. At Benton-New Diggins, the Mineral Point Zinc Co. continues to operate the Hoskins and Penna Benton. Here the Vinegar Hill is operating a new property, the Fields-Meloy. The Frontier Mining Co. is running the Bull Moose and Middie. The Lawrence Mines Co. operates the Indian Mound. The Wisconsin Zinc Co. has closed its string of producers, but continues prospect work and is re-milling tailings. At Hazel Green, the Vinegar Hill has just closed the Jefferson, but has taken over the Monmouth and reopened it. At Shullsburg, the Rodham and Imperial are active. At Galena, the Mineral Point Zinc Co. operates the Black Jack and the Vinegar Hill Zinc Co. the North Unity.

Lead-Silver Discovery Reported in Alberta

The discovery of lead-silver ore at Milk River, Alberta, is said to have created a little excitement in that part of Canada. It is said that the usual rush of would-be stakers has taken place and that some drilling is being done. The report has not been verified up to the present.



MONUMENT ON BOUNDARY BETWEEN ALASKA AND BRITISH COLUMBIA. THE RE-SURVEY OF WHICH LINE IS NOW UNDER WAY

Boundary Re-Survey Under Way in Portland Canal District

Both Governments Seek To Obviate Chance of Dispute as to Nationality of Mineral Ground

The work of re-defining the international boundary between Alaska and British Columbia in the Portland Canal district is under way at the present time. Parties representing the United States and Canadian governments are doing the work, erecting stone cairns and bronze monuments on the mountains, and hewing a lane twenty feet wide through the forest. This is the second time in about sixteen years that this has been done, the line having become overgrown in the meantime and difficult to recognize. The Canadian party is in charge of J. D. Craig. The chief purpose in making this resurvey is to obviate all chance of dispute as to the nationality of valuable mineral claims located or that may be located in the district. The Premier mine is the most important property of the district but there are others of promise.

To Extend Pine Creek Railroad in Coeur d'Alenes

Milwaukee Lumber Co. Reaches Agreement With O.-W. R. & N.—Will Benefit Mining Companies

Definite announcement has been made that an agreement has been reached between the Oregon-Washington Ry. & Navigation Co. and the Milwaukee Lumber Co. by which the latter will take over the Pine Creek branch and extend it to the forks of the creek, two miles and a half, and thence four miles up the west fork to a large body of timber owned by the lumber company. The track now extends up Pine Creek a little more than two miles and the right of way is cleared to the forks. The road is in the Coeur d'Alenes.

The construction of this branch will be of great benefit to the mining interests of the section. The Nabob, in particular, which has its mill near the forks of the creek, will at once be relieved of a wagon-road haul of five miles, which will mean a direct saving of at least $4 per ton on all shipments. The Highland-Surprise, which has a 100-ton mill, is preparing to ship and the railroad will reduce its wagon haul by half. Other properties, with ore available for shipment, that will be directly benefited, are the Douglas and Constitution, the latter of which has a 125-ton mill. Numerous development companies will be encouraged in the work of finding new mines.

Kinney, Minn., Wins Case Against Cleveland-Cliffs

The U. S. Circuit Court of Appeals has sustained the District Court in its findings for the Village of Kinney, Minn., in the case of the Cleveland-Cliffs Iron Co. versus the Village of Kinney. The case involved the annexation of property in and around the Wade mine by the village and has been long fought out. Starting with an injunction to stop the initial election called for the purpose of sanctioning the annexation, it was later taken to the district court in an effort to overturn the outcome of the election on the ground of illegality. Losing there, it was referred to the Court of Appeals, which court has now sustained the voters and the lower court. About 2,500,000 tons of developed ore are involved.

Fifteen-minute speeches will be made at the ceremonies to be held at the end of the Mine Rescue Meet in Denver next week. The speakers will be: Governor Oliver H. Shoup, of Colorado; Mayor Dewey C. Bailey, of Denver; W. H. Huff, of the Victor American Fuel Co.; J. F. Callbreath, secretary of the American Mining Congress, and John L. Lewis, president of the United Mine Workers of America. Dr. F. G. Cottrell, the director of the U. S. Bureau of Mines, will present two sets of prizes; namely, the Joseph A. Holmes medals and the prizes for the winning teams.

Sulphide Cut by Boras Leasing Co., at Warren, Ariz.

First To Be Found in This Section of District

The Boras Leasing Co., at Warren, Ariz., has struck sulphide ore in a drift on the 600 level in the Space claim. Although this section of the Warren district has produced considerable oxidized copper ore, the sulphide now being opened up is the first to be discovered. The new strike will therefore be watched with much interest.

Civil Service Examinations

Those interested in the following examinations should apply to the Civil Service Commission, Washington, D. C., for form 1,312, stating the title of examination desired:

Associate physicist qualified in physical metallurgy, $2,000-$2,800; assistant physicist qualified in physical metallurgy, $1,400-$1,800; both sexes. An open competitive examination; no date given. Vacancies in the Bureau of Standards, Washington, D. C., may be filled from the results of this examination.

Metallurgical laboratorian, $4.80 per day (or higher or lower salaries); both sexes. An open competitive examination; no date given. Vacancies at the Engineering Experiment Station, U. S. Naval Academy, Annapolis, Md., may be filled from results.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Bureau of Mines Analyzes Its Expenditures

Research on Metalliferous Minerals Accounts for 60 Per Cent of Money Spent on Stations

An analysis has been made of its expenditures by the U. S. Bureau of Mines. Expenditures chargeable to mineral mining, ore dressing, and metallurgy, and to mining and preparation of earthy minerals are calculated by the bureau to be as follows: Mine accidents, $52,669; mineral mining, $125,000; mine rescue cars and stations, $90,223, and engineering experiment stations, $170,000. This makes a total of $437,892, or if ceramics and earthy minerals be deducted the total would be $400,892.

Expenditures classed as chargeable to coal mining and combustion are as follows: Mine accidents, $268,682; fuel testing, $142,510; mine rescue cars and stations, $64,444, and engineering experiment station, $5,000.

The bureau figures that metal mining, ore dressing and metallurgical research on metalliferous minerals account for 60 per cent of the total for mining experiment stations; ceramics, 12½ per cent; petroleum, 12½ per cent; non-metallics, not including coal, 12½ per cent, and coal, 3½ per cent. Two-thirds of the mine accident appropriation is spent in coal mining districts and one-third in metal mining regions. The ratio of coal miners to metal miners is figured at 4 to 1 and the bureau holds that its division of the appropriation is a natural one. In that connection the following figures were compiled as to the value of mineral products in 1918. They are as follows:

VALUE OF MINERAL PRODUCTS IN 1918

	Value of Product	Percentage of Total
Coal	$1,801,480,347	32.63
Petroleum	690,190,000	12.51
All other non-metallic	874,653,000	15.84
Pig iron and ferro-alloys	1,296,193,500	23.47
All other metallic	856,945,500	15.55
Total	$5,519,462,347	

May Revise Income Tax Forms

Suggestions for the revision of income tax forms may be made at a hearing which will be conducted in Washington, Sept. 15, under the auspices of the commissioner of internal revenue.

War Minerals Awards

Awards recommended by the War Minerals Relief Commission during the week ended Aug. 21 aggregate $10,945. They are as follows (the name of the company, the mineral, the amount recommended and its percentage relationship to the amount claimed are shown): Southern Pyrites Ore Co., pyrites, $8,790.39, 12 per cent; Booker, Booker & Gibbs, chrome, $101.45, 26 per cent; D. McDonald, manganese, $639.31, 12 per cent, and W. G. Fitzgerald, chrome, $413.85, 58 per cent.

Chamber of Commerce on Mining Conditions

A report to the Chamber of Commerce of the United States by its Committee on Statistics and Standards has the following to say in regard to mining conditions:

"Whether mining is busy and prosperous or the reverse depends upon the nature of the metal. Gold mining still suffers from high costs of production and the stationary price of gold. Silver mining feels the effect of the decline in its price. The price of zinc is low and the demand is not equal to

the possibilities of supplies. Lead is higher because of increased demand. Copper is dull because of a supply not yet disposed of. Iron mining is good. Phosphate mines in the South are doing well after many lean years.

"Contraction and financial credits have put wildcatting in the oil regions out of business. This makes for dullness because supplies for drilling oil wells are no longer called for.

Farmer vs. Mine Operator

That the Federal Government is much more generous to agriculture than it is to the mining industry is shown by the fact that it spends only one-thirteenth as much for the promotion of the interests of the mining industry as it expends for the agricultural industry. In 1918 the total value of mineral products was roughly five and one-half billion dollars, while the value of agricultural products totaled twenty-two and one-half billion dollars. Thus the ratio of economic importance was about one to four.

Mineral Shipments Via Panama Reported

The movement of nitrate of soda through the Panama Canal during June totalled 109,953 tons. Two cargoes went to Charleston, S. C.; three to the United Kingdom; one to Norfolk; three to Baltimore; two to Philadelphia; three to Wilmington, N. C.; one to Boston and two to New York.

Only one cargo of copper moved through the canal during the month. It consisted of 2,500 tons and was shipped from Valparaiso to New York.

The fuel oil movement totalled 60,643 tons. This oil originated in Mexico and went to Chilean ports with the exception of one cargo which went to San Francisco.

Four cargoes of sulphur passed through the canal during the month under review. The total tonnage was 14,700. Three cargoes originated at Galveston. Two of them went to Portland, Ore., and one to Vancouver, B. C. A cargo originating at Sabine, Tex., went to Melbourne. A cargo of phosphate rock moved from Tampa, Fla., to Osaka, Japan.

Survey Preparing Estimates for Next Fiscal Year

Estimates are being prepared by the U. S. Geological Survey for its work during the fiscal year beginning July 1, 1921. The estimates will not vary importantly from those made for the current fiscal year, which, however, were reduced somewhat by Congress. The estimates made last year were as follows:

For geologic surveys, $500,000; investigation of the mineral resources of Alaska, $100,000; mineral resources of the United States, $200,000; chemical and physical researches, $60,000; topographic surveys, $600,000; water supply investigation, $200,000; land classification, $400,000; printing and engraving of maps, $140,000, and superpower survey, $250,000. The total of these is $2,450,000.

NEWS BY MINING DISTRICTS

MEXICO

Sonora

Pumps Pulled at Democrata Mine

Cananea — The Democrata mine is now completely shut down and for an indefinite time. The pumps have been pulled and the mine will be allowed to fill. The water will probably rise to about the fourth level. The reopening of the mine will depend upon the price of copper and the possibilities for marketing the same.

Hidalgo

Companies at Pachuca Operating on Larger Scale Than Before

Pachuca—Mines of the Pachuca district have for the most part been running steadily throughout the revolutionary period and are now operating on a larger scale than ever before. The drop in the price of silver, while felt by the companies, has less effect here than elsewhere as the Pachuca ores are of a higher grade than in some other districts. The area of the camp is only 3 by 5 miles and in it about 15,000 workmen are employed, most of them Mexican, there being only about 100 foreigners, mostly Americans, among them.

The largest operator is the Cia. de Real del Monte y Pachuca, which at present is working twelve shafts. Like some other Mexican operators, this company has been hauling its supplies for several years from the border at Laredo in freight trains pulled by its own locomotives. The trains are made up only of cars consigned to the company and run straight through from Laredo to Pachuca, taking about five days for the trip, a distance exceeding 600 miles. The road used is the Government owned main-line, the roadbed of which is and has been kept in excellent condition, the occasional destruction of a bridge excepted. The road, when built years ago, was laid with heavy rails and is said to be in as good shape today as many in the United States. For those supplies that come from within Mexico, such as limestone, the company has its own cars on account of the difficulty of obtaining rolling stock.

Power is obtained from the Mexican Light & Power Co. largely from its principal hydro-electric plant at Necaxa, about 100 miles away. Since operating supplies have been received in requisite amounts operating conditions have been very satisfactory.

Chihuahua

Madera—The Dolores Esperanza Mining Co. is overhauling its mill at the Dolores property and is installing turbo-generators at Madera. The tunnel on the 400 level is being caught up and will give access, when the work is complete, to the old Dolores workings on the 400 level and to the new Esperanza ground. The shaft is being pumped out to the 700-ft. point. At the El Rayo a winze on the bottom level is being unwatered, in which good ore had been cut before the property was shut down.

Zacatecas

Fresnille—The Mexican Corporation has taken a twenty-year lease on the Proano mines in the Fresnillo district and is installing a 2,000-ton mill, which is to be ready early next year.

PERU

Peruvian C. & S. Co. To Start Producing in November

The Peruvian Copper & Smelting Co. has increased its force to 850 men, who are employed in part on the work of finishing the construction of the new auto-truck road. The rest of the men are engaged in mining coal and copper, and in making coke. A number of new strikes of ore running about 20 per cent copper have been made on the G and J levels, the levels being 300 ft. apart, at the Yauricocha mine. It is expected that the new 200-ton blast furnace will be ready to blow in this November, by which time the company will be able to go on a production basis. The company also has a small reverberatory of negligible output. At the coal properties at Jautenhuasi, fourteen tunnels are now being driven on the veins. The announced purpose of the company is to produce copper, coal and coke for shipment. J. N. Vandegrift, the manager in Peru, is at present in New York. The president of the company, J. A. Vandegrift, is now in Peru. It is stated that if development continues as at present in the Yauricocha mines, the company will feel warranted in erecting a thousand-ton smelter.

CHILE

Santiago — Cia. de Minas de Cobre de Gatico has recently installed a powdered-coal-fired reverberatory with a bed 80 ft. long by 18 ft. wide, which is operating successfully on Chilean coal. The furnace is said to be smelting 200 tons of cold charge per day and consuming one ton of coal for five tons of charge smelted.

AUSTRALIA

Queensland

Mt. Elliott Still Down—Mt. Cuthbert's Start in May Fails—Hampden Cloncurry in Full Swing

Brisbane—In the Cloncurry copper field matters are not looking promising for the increased yield that was expected this year. The Mt. Elliott company, having failed to obtain capital from the American financiers to whom they appealed, is still in a state of inactivity, and the prospect of their Mt. Oxide mine, away to the northwest of Cloncurry, being made accessible and consequently productive seems almost as far off as ever. While the state government has authority to extend the Cloncurry railroad to a point nearly twenty miles from this mine, British capitalists have turned down the state premier's personal appeal to them for a loan, and there is not likely, as far as can be seen at present, to be money available for an indefinite period for the building of the authorized extension.

The Mt. Cuthbert company, which in May started what promised to be a successful campaign, closed down on June 21, and had not started again toward the end of July. The reason for the cessation of operations was given out as being the inability of the company to obtain further advances on a large accumulation of copper in transit or at the refining works.

The only other large company in the district, the Hampden-Cloncurry Copper Mines, is still in full swing, and a good many small mines and "gougers," or nomadic individual miners, are operating, but these are being handicapped by the reduced price of copper combined with the high cost and scarcity of mining requisites and commodities generally.

CANADA

Ontario

To Build Flume from Cobalt Mills to Cross Lake—Herrick Mine Plant Completed — McIntyre Shareholders Object to Purchase of Alberta Coal Mine

Cobalt—The lessees of the Ruby property in Cobalt have struck a small vein of high-grade and are preparing to ship.

Three new veins have recently been encountered in the underground workings of the Lumsden, one of which is reported to carry high-grade.

To dispose of about 2,000 tons of tailings a day from the Nipissing, Mining Corporation, Coniagas, and Northern Customs mills, it will be necessary to build a tailings launder to Cross Lake, at a cost of about $25,000. At present, the tailings go into the creek, but the outlet from Cross Lake is becoming blocked. It is thought that if the tailings are carried into the main body of the lake the clear water will cut a channel through them.

West Shining Tree—At the Herrick property in Shining Tree the installation of the mining plant has been completed. The shaft is being enlarged and retimbered and will be continued to a depth of 200 ft. The government has recently completed the building of a wagon road from the railway at Westtree to Shining Tree Lake, a distance of 20 miles.

Porcupine—The Porcupine district has again been ravaged by forest fires. The town of South Porcupine was in serious danger of destruction for two days and was only saved by the most strenuous exertions. No loss to mining properties has been reported.

Gold has been struck in a drill hole put down to the depth of 2,400 ft. below the surface from the 1,250-ft. level of the Hollinger Consolidated. The gold content of the drill core was not large, but a satisfactory result is that the geological formation at depth was found to be the same as that between the 1,250-ft. level and the surface.

The circular recently issued by the Dome Mines Co. to the shareholders, advising the taking over of the Dome Extension, states that a large body of payable ore has been opened up on the 600-ft. level of the latter property.

It is understood that the last four months' operation of the Trethewey in Gowganda has paid for all development and, in addition, has indicated a substantial reserve of high grade.

The Davidson has secured sufficient English money to fully develop and equip the property. Sufficient treasury stock will be sold at 75c. a share to net the company $1,125,000, the purchase to be completed by April 1, 1921. In addition they secure a two-years' option on 2,000,000 vendor's shares, half at $1 and the balance at $1.25 a share. A 500-ton mill is to be constructed in the near future.

A number of McIntyre shareholders are very critical of the company's purchase of a coal mine in Alberta. The company is paying about 15 per cent a year in dividends, but has not been able to build up ore reserves commensurate with the size of its operations. Some shareholders consider that, in view of the expenditures which will have to be made on development account at the McIntyre, they are entitled to larger returns before the surplus is put into another operation as far away as Alberta.

Kirkland Lake—It is understood that the Murray-Mogridge property in the Kirkland Lake section has secured sufficient money to finance development work.

The Lakeview property, adjoining the Murray-Mogridge, is installing a steam plant.

The Ontario Kirkland is proceeding with the construction of a 60-ton mill, and expects to haul in the machinery this winter.

It is officially stated that the Sylvanite is not included in the proposed amalgamation of the Tough Oakes, Burnside and Cobalt Aladdin properties.

Kirkland Lake—The Lake Shore during July produced $52,424 from the treatment of 1,860 tons of ore, the mill heads averaging $28.18 per ton. The total output for the year is now $339,427. A station has been cut at the 400-ft. level and preparations are being made for sinking a 3-compartment shaft to the 800-ft. level.

Blue Mountain—The old Mica mine at the head of Stony Lake, Peterborough County, has been purchased by C. L. Nicholson, of New York, and Norman Miller, of Michigan, who will start operations this fall.

Manitoba

Rice Lake—J. B. Tyrrell has presented a report on the Gabrielle mine, stating that assays offer little promise of returns from the property and advising that work be discontinued. The directors have determined to carry on operations next year.

British Columbia

Trail—Ore shipments received at the Consolidated smelter during the week ended Aug. 21 were as follows:

Mine	Location	Gross Tons
Bluebell,	Riondel	314
Josie,	Rossland	171
Mandy,	Le Pas, Man.	1,080
Molly Hughes,	New Denver	23
Monarch,	Field	36
Venus,	Carcross, Y. T.	34
Company Mines		7,253
		8,911

CALIFORNIA

Champion Plant Being Wrecked—Gruss Copper Co.'s Mill Started—The Trinity Copper Transfer

Grass Valley—All of the underground machinery, pumps, rails and, in fact, everything of any value, has been removed from the depths of the Champion mines and what has not been sold is now on the surface. The hoisting plant at the Providence shaft has been purchased by the Empire Mines. All the men except four have been discharged, those still employed being used in tearing down the large dry house. The milling and hoisting plants on the Champion side are still intact. It is rumored that different parties are planning on securing a bond on the Champion holdings and that the property is not likely to be closed long.

The Boundary Mines Co. has purchased the hoist and power plant of the Empire Mines at the Osborne Hill mine, and will install them at once at the Boundary. A large pump will also be installed. All underground work has been suspended during this work.

Officers of the Tightner Mining Co. were elected at the recent annual meeting as follows: President J. M. O'Brien, of San Francisco; vice-president, Dr. C. P. Jones, of Grass Valley, and secretary, C. H. Taylor, of Grass Valley.

Sonora—Frank Willetts, who for the last two years has operated the Wetmore's Dream mine, will open and develop the Mangente mine near Sonora. Machinery is being removed from the Wetmore properties to the Mangente

mine and a compressor, hoist and engine will be installed at once. Development work will be undertaken.

Quincy—The Kelly quartz mine, nine miles from Quincy, is being prepared for active development work by Kelly brothers, owners. A tramway, approximately 1,500 ft. long, will soon be constructed, and for this purpose all material, such as steel cable, lumber, etc., is on the property.

Redding—Papers filed for record at Redding show that little cash changed hands in the transfer of the claims of the Trinity Copper Co. to the Trinity Copper Corporation, as they bore no revenue stamps. The stockholders in the old company received a proportionate number of shares in the new company and the treasury stock remains in the treasury. The properties lie west of Kennett. The Trinity Copper Co. was organized by Thomas Lawson for trading on the Boston stock market. The deeds filed for record show that the Trinity Copper Co.'s sixty mines near Kennett were sold in Jersey City, N. J., on Jan. 19, 1920, to George A. Haskell, of Boston, for $210,000. Haskell immediately sold all the property to the Trinity Copper Corporation for $1. The latter company is incorporated under Virginia laws, while the old company's charter came from New Jersey. The principal mine of the company is the Shasta King, though sixty or more claims are owned. All tracks were taken out of the mine three years ago, and the Shasta King has become almost forgotten locally.

Portola—The Gruss Copper Co. in Genesee Valley, a few miles from the Engels and Walker properties on the same ridge, started its new 15-stamp mill Aug. 20. A flotation plant has been installed. The bins and dumps are stacked with ore that runs from $15 to $127 per ton and there is estimated to be sufficient ore in sight to keep the mill running for at least one year.

Colfax—The 900-ft. shaft on the Rising Sun gold quartz property has been entirely unwatered for the first time in years. The ledge is said to be 3 ft. wide in the bottom. The mill is running on night shift only. Twenty miners under E. C. Klinker are employed.

Death Valley Junction—The Pacific Coast Borax Co. is planning to enlarge its mill at Death Valley Junction by adding two more roasters which will increase the capacity about 60 tons per day, according to Fred W. Corkhill, mill superintendent. The plant is being operated with a 286-hp. semi-Diesel engine which generates power for the entire plant, lights the town, and operates a one-ton ice plant. Twenty-one miles of a narrow-gage railroad, 3 ft. wide, connect Death Valley Junction with the Lila C. and Ryan mines.

Death Valley is notoriously hot in the summer time, notwithstanding which fact there is less trouble in keeping a good supply of labor than in more favored camps. This is largely due to the methods inaugurated by Major Julian Boyd to make the men employed as comfortable as possible. The bunkhouses are two three-story concrete buildings, with hollow walls, each being 110 ft. in length, and accommodating 400 men. The hollow walls make the buildings comparatively cool in summer and easy to heat in winter, besides which they are said to rival a modern hotel in completeness of appointments.

NEVADA

Large Tonnage of Silver Ore Proved at Candelaria—Silver Peak Chemical's Mill Ready, but No Water

Tonopah—Bullion shipments to date indicate a gross production for August for the Tonopah district of about $500,000. This is normal. The principal mines of the district, the Belmont, West End, Tonopah Mining and Tonopah Extension, report regular development operations with nothing new of importance. Of the smaller mines, the Rescue, California Tonopah, MacNamara, Midway, and Halifax are regular shippers.

The Spanish Belt management have announced through their consulting engineer that their ore reserves in this property consist of 75,000 tons of probable ore of an average grade of between $20 and $30 per ton. This mine is about 60 miles north of Tonopah and about ten miles northwest of the old camp of Belmont.

Divide—Rumors are plenty regarding a new ore estimate for the Tonopah-Divide mine and there seems to be some basis for the optimistic feeling that prevails regarding the ore reserves in this mine at least. Interest is reviving in the smaller properties throughout the Divide district and during the last few days several properties which have been closed down for months resumed operations. The Gold Zone has a very creditable showing and is regarded as a prospective shipper. No other mines have reported development of importance.

Candelaria—The Candelaria Mines Co. is doing about 1,000 ft. of development per month with forty-five men. The work is confined largely to the Lucky Hill, the company's new property. Since the Candelaria mines passed into the control of interests affiliated with International Nickel the property has been thoroughly sampled and from the results of over 8,000 assays a large tonnage of ore has been proved to average between 12 and 15 oz. silver. In addition to the proved ore, and the disclosures made in recent development on the Lucky Hill, there are numerous places with good showings which will be developed later. E. E. Carpenter, who is in charge of operations, states that the Candelaria will soon be a big silver producer. The metallurgy has been worked out but mill construction is not expected to start for several months. The first unit will have a capacity of from 125 to 150 tons daily, and the process will consist of coarse grinding, roasting and cyaniding. Roasting will be followed by a short leach.

VICTORY SHAFT, TONOPAH EXTENSION MINING CO., TONOPAH, NEV.

Silver Peak—The reduction plant of the Silver Peak Chemical Co., which is expected to turn out about 100 tons of pure potash alum daily from its property near Blair Junction, in Esmeralda County, is reported to be practically completed. Its start has been delayed, however, owing to a failure of the water supply figured on. A well is now being sunk out on the flats.

Arrowhead—The west drift on the 215-ft. level of the Arrowhead Consolidated has recently broken into good ore, according to Dr. Elftman, who is heavily interested. The original Arrowhead mine is making small shipments to the MacNamara mill at Tonopah.

ARIZONA

Jerome Verde Suspends Operations Indefinitely

Jerome—Jerome-Verde recently followed the example of Gadsden and suspended operations indefinitely. The mules have been brought out, the pumps pulled and preparations made to leave the property in good shape. Development work had been planned on the 1,200 level, corresponding with the 1,500 in the U. V. Extension. This was designed to get below promising looking oxidized and leached ground on the 1,100 level, thought to be the top of an orebody. The money was to have come from a bond issue, but the stockholders failed to back the plan. Jerome-Verde has a large acreage in the heart of the Jerome mineralized section. Several small bodies of ore have been tapped and some ore sent to smelter.

Globe—The Superior & Boston has found in resampling that the 1,250-ft. level contains ore available for immediate shipment that runs from 3 to 25 oz. silver and averages 13½ oz. over a 5-ft. width. The stopes in the footwall vein on the 4th level west are in good shipping ore, likewise the raises at the eastern end of the 4th and 6th levels. The south crosscut is expected to cut the Rigby vein soon.

NEW MEXICO

Duncan M. & M. Co. Shut Down, Pending Readjustment

Lake Valley—The Lake Valley Silver Mines Co. continues to ship silver and manganese ores regularly. Some high-grade crystalline manganese ore has been encountered.

Silver City—The Santa Fe has enlarged its ore-loading platform. This is intended to facilitate ferromanganese shipments moving to Pittsburg territory, principally from the Amory Stevens property.

The Silver Spot mine shipped a car of manganese ore to Pittsburg recently. The water flow in the main shaft is under control and mining on the 140-ft. level is under way. Bulkheads have been installed to guard against contingencies.

Carlisle—The old Carlisle mine and mill is being operated under lease by G. A. and L. Utter. A car of concentrates will be shipped to the El Paso smelter at once.

Steeplerock.—The Duncan Mining & Milling Co.'s plant has been shut down pending readjustment of financial affairs. The statement given out by W. H. Evans, former manager, of $20,000 returns from the first clean-up of the cyanide mill made about Aug. 7, has not been confirmed by the engineer in charge, who gives the amount as $1,695.

Lordsburg—The Bonney Cons. is following up a number of high-grade ore showings recently opened on the surface. Twenty men are employed. All mechanical equipment is being overhauled and pumps prepared for heavy work to start soon.

COLORADO

Diamond Drilling Progressing Near Gillett—First Hole Down 1,100 Ft.

Cripple Creek—Prospecting with a diamond drill, financed by the Cresson, Vindicator, and Golden Cycle companies, is under way in the vicinity of Gillett. George A. Stahl, general manager of the Vindicator, and W. H. Trask, of Denver, are in charge. The first hole is down 1,100 ft. At 1,084 ft. the hole is cut through the granite formation, then passed through 6 ft. of breccia, then 3 ft. of quartz and fluorite, then phonolite. The record made by the drill is reported to be gratifying. Mining men who are familiar with the Cripple Creek crater are much interested in the outcome of the enterprise.

Silverton—The Mazeppa mine, in the South Mineral district, is being developed by Samuel Heindel. A shoot of high-grade lead sulphide ore has been opened.

Mayday—Dr. W. B. Cauble, of Peoria, Ill., has secured a half-interest in the Esmeralda Convention group on the south fork of Lightner Creek from George and Milton De Luche and George Smart of Durango. A 35-ton mill will be erected.

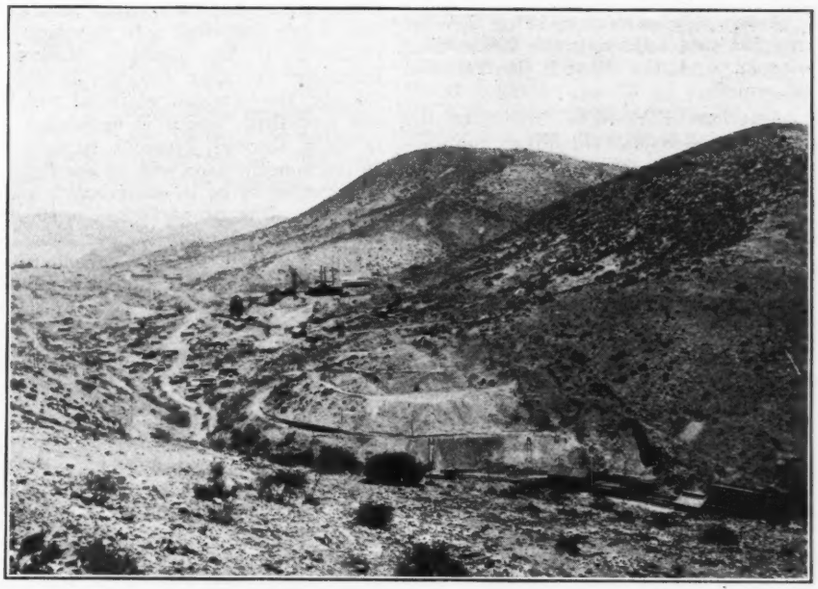
The Mayday Leasing Co., which has been working the Mayday dumps, has quit.

Moffat County—During the last summer an attempt was made to operate one of the old placer mines in Moffat County, Col., by its owners. The attempt was not highly successful due to a heavy snow fall late in the spring and the consequent floods which washed out a series of small supply dams. As it is necessary to store the water from early in the season to maintain a supply for the entire summer, work was hampered considerably. In spite of these conditions a small plant was put into operation and run for a short time. Preparations are being made to operate a larger plant on the same ground next season.

The neighboring mines have been idle during the summer and it is doubtful when they will be worked again. During a lull in the operations for the last few years a large percentage of the land has been located for farming purposes and in some cases conflicting with the placer locations.

There are two small dredges in the district, both of which have been worked off and on for several years. It is understood that one of these dredges has been leased to an Eastern stock company and is to be run the coming season.

Very little of the ground has been prospected to any extent and the best average value is between 40 and 50c. per cu.yd. There is however practically no overburden, the dirt running from the surface down 6 to 8 ft. to a soft sandstone bedrock. The source of the mineralization is doubtful but the general theory is that it is from Hahn's Peak or vicinity, about 20 miles to the east.



LOOKING NORTHEAST UP COPPER GULCH, GLOBE DISTRICT, ARIZ. RIGHT FOREGROUND — NO. 1 SHAFT ARIZONA COMMERCIAL MINING CO. LEFT CENTER—MINE PLANT OF IRON CAP COPPER CO., NEW IRON CAP MILL AT LEFT IN DISTANCE. SUPERIOR & BOSTON'S HOLDINGS LIE SOUTHEAST OF THOSE OF ARIZONA COMMERCIAL AND IRON CAP

UTAH

King Con. at Park City Cuts New Fissures—Silver Shield at Bingham Levies Assessment

Silver City—Tintic Milling shipped a car of bullion the week ended Aug. 16. About 150 tons of ore is being treated daily, as the plant, owing to a scarcity of ore, is not running at capacity. One shift is working in the crushing department and three in the leaching and roasting departments. As has been stated before the company is making

changes and improvements in its equipment to permit the separation of the copper from the silver and gold, which will make it possible to ship the bullion directly, without further refining, to the U. S. mint.

Development is being done on the 2,200 level of the Iron Blossom in the hope of finding ore at depth.

Eureka—The Chief Consolidated expects to add to its earnings through its new leasing system whereby entire stopes are given over to groups of miners, who make more money in this way, the company at the same time being safeguarded by especial contracts. The practice of giving other leases where there are only small showings of ore is still in force, the lessee undertaking the work of development.

The Iron King is drifting on both the 1,000 and 1,500 levels, as well as shipping about a car of fluxing iron ore daily. The latter is coming from above the 350-ft. level.

The Eureka Bullion has resumed work after a month's intermission for repairs to equipment.

Active development is being done at the Emerald adjoining the Centennial-Eureka and the Grand Central and Mammoth.

American Fork—The tunnel of the American Consolidated Mines, embracing the old Bog property and adjoining ground, has cut at 1,800 ft. the fissure for which it was being driven. Drifting both ways has been started on the fissure, which is 10 ft. wide at the intersection. Some mineralization shows the fissure to be the same which produced considerable ore in the Bellerophon.

Gold Hill—The Western Utah Copper in the Deep Creek district is to increase its shipments of lead-silver ore largely. A railroad into this district was completed two or three years ago.

Bingham Canyon—The Silver Shield reports that a change in the character of the orebody from which a number of shipments were made has resulted in a loss to the company. The lead ore has been replaced by zinc. Improvements made since the ending of the war have resulted in an indebtedness of about $18,000, to meet which an assessment of 3c. per share has been levied.

Alta—The winze from the 300-level of the Emma Silver shaft has been unwatered to about 75 ft. below the level. Diamond drilling is to be started again when this work has been completed and ore will be shipped from the Emma stope. Prospecting is being done in a number of places in the mine.

The Alta Tunnel & Transportation Co. has let a contract for the extension of its east drift, in the face of which oxidized vein matter with some galena is beginning to show. Ore was opened further back some time ago and is said to be 6 ft. wide with more high-grade showing as development progresses. Poles for a power line have been cut and seasoned. The road from the property is being improved.

Big Cottonwood—Some ore is being taken out at the Woodlawn property. The tunnel face at the Cottonwood King is entering gray limestone showing iron and copper stains.

Park City—The Judge Mining and Smelting is encouraging the employment of married men on its working force.

Silver King Consolidated is reported to have cut another set of fissures in the tunnel which it is driving both for the purpose of exploring new ground and for making connections with its California-Comstock holdings. The tunnel has almost reached its objective point.

The Park-Utah is developing and extracting ore in the south drift from the crosscut. Paul Hunt is superintendent.

IDAHO

R. N. Bell Takes Option on Red Bird at Clayton—Ramshorn Mill at Bayhorse Running

Clayton—Robert N. Bell, the retiring state mine inspector, has secured a long lease and option to purchase the property of the Clayton Mining & Smelting Co. near Clayton in Custer County, the principal claim of which is the Red Bird, which is developed 900 ft. deep through crosscut tunnels. A 50-ton concentrator will be erected and is expected to be in commission within 60 days. The property has a 100,000-ton reserve of 10 to 15 per cent lead ore in the form of sand carbonate associated with a soft limonite gangue. The silver averages about ¾ of an oz. per unit of lead and extensive mill tests indicate a good recovery by simple jigging and table concentration.

The mine is 65 miles from the nearest railway shipping point at Mackay and involves a truck or wagon haul charge of $20 per ton. The mine has produced $1,500,000 in its past operations, $300,000 of which has come from lessees operating on a small scale, who have been "gouging" for rich pockets of high-grade ore during the last three years.

Bayhorse—At Bayhorse the new concentrator of the Ramshorn Mines Co. has been in operation for the last two months. Although difficulty is being experienced in holding down the tailings losses, owing to the large proportion of silver chloride in the ore in spite of a preliminary sulphidizing bath and a modern flotation plant, a product of 300-oz. concentrates is being made that is gradually being improved upon. A lower adit, now being reopened for stoping, carries a more primary ore that will give a much closer saving in milling. The Ramshorn vein is a very persistent steep fissure in slate that was formerly extensively developed by adit tunnel but idle for 25 years until the present operation, which was started two years ago. It has an ore shoot 1,000 ft. long, except for a few short pinches, that varies from 1 to 5 ft. in width.

The Beardsley mine, at Bayhorse, is being operated by lessees and is developing much good ore. Between 700 and 800 tons of ore are now on the dump, that averages 20 per cent lead and 40 oz. silver per ton. This new development, on an old property idle for 25 years with a former record of several million dollars produced, is more definitely related to a pronounced contact of limestone and shale than any of the other ore shoots formerly worked. The inference seems permissible that only the blossoms of this important contact have been developed and that the string of other properties extending for more than 2 miles along the vein may prove equally productive.

Mackay—In the Mackay district of the same county, the Empire Copper Co. is operating 20 small leasing units and shipping about a car of crude 5-per cent copper ore per day to the Salt Lake Valley smelters. The ore also runs well in silver and gold.

In the adjoining limestone-lead belt the U. S. Smelting, Refining & Mining Co. is developing two very promising lead-silver prospects, one of which, the Horseshoe group, is shipping 20 cars a month of low-grade lead-silver ore carrying 12 per cent lead and 10 oz. silver and an excess of iron oxide. The Kennedy group, of the same company, now developed 250 ft. deep, has one ore shoot 40 ft. wide and 60 ft. long.

At the Doughboy adjoining, a 25-hp. gasoline hoist is being installed. There is an inclined shaft, 300 ft. deep, sunk on a persistent contact fissure vein 3 to 5 ft. wide, disclosing a pay course of rich jigging ore in the form of hard carbonate and galena carrying silver in a gangue of lime porphyry breccia.

The lead-silver ore of the Mackay copper district occurs in paleozoic limestones extensively intruded with nearly vertical porphyry dikes. The ores have proven almost completely oxidized so far to a maximum depth of 300 ft. They occur usually in a succession of lenses and pipe-like shoots at the contact of the nearly vertical dikes and locally marbleized blue limestones, and give decided evidence of permanency.

Coeur d'Alene District

Red Monarch Con. To Resume—St. James and La Fleur Consolidate

Wallace—The Red Monarch Consolidated Mining Co. is preparing to begin work after a year's suspension. The property is on Beaver Creek and the main development is a crosscut tunnel 4,400 ft. long which has cut three promising veins. The first is 2,900 ft. from the portal and a drift several hundred feet long and a 75-ft. raise have exposed considerable lead-silver ore. It is now proposed to sink on the ore.

The St. James Mining Co., which owns a group of claims on Sunset Peak covering an extension of the famous Sunset vein, and the La Fleur Mountain Copper Mining Co., which has a copper property in Stevens County, Wash., have been consolidated, the new company being called the St. James-La

Fleur Mining Company. In the formal announcement of the merger the president of the St. James states that it is expected that the earnings of the La Fleur will provide funds for the development of the St. James.

An important strike of lead-silver ore is reported in the Bryan property, about five miles from Saltese, Mont., on the west fork of Packer Creek. The strike is described as 7 ft. of ore, having high values in silver. Control of the property is owned by the Days, of Wallace.

MONTANA

Anaconda Experimenting With Storage Battery Locomotives—Butte-Jardine Breaks Ground for 100-Ton Plant

Butte—For some time Anaconda has been experimenting with three different Edison storage battery locomotives. Others have been ordered but deliveries are slow. An official of the company has expressed himself as being highly satisfied with results to date, although no data have as yet been assembled as to relative cost of these compared with trolley locomotives. The chief difficulty that the company had experienced in the use of trolley locomotives had been in protecting the overhead wire at the mouths of chutes, where it was difficult for a workman to avoid striking it with bars.

The Nettie and the Emma mines, the latter the property of the Butte Copper & Zinc Co. but being operated under lease by Anaconda, are popularly considered among the best earning mines of the Anaconda at present. From the Nettie is coming a considerable tonnage of silver ore. Manganese ore is being mined at the Emma, a portion of which is being shipped to the ferromanganese plant at Great Falls, Mont., and the balance direct to eastern rolling mills.

Deeper development at the Black Rock mine of Butte & Superior appears to indicate a lessening of the iron content with an increase in the zinc. Results attending the employment of more than 1 per cent of oil in the flotation process at the Black Rock mill are proving satisfactory, 97 per cent being shown for July, 3 per cent more than the monthly average for the past few months and 4 per cent more than for June. Under the ruling of the United States Supreme Court in the Minerals Separation case, to avoid patent infringement more than 1 per cent of oil must be used per ton of ore, and this the Butte & Superior seems to have accomplished. Butte & Superior ores are averaging from 14 to 15 per cent of zinc and slightly more than 5 ounces of silver per ton.

Net earings of Tuolumne Copper are ranging around $18,000 monthly. Sinking of the Main Range shaft from the 1,200 to the 2,000 ft. level is expected to start within a week or ten days.

The objective vein of the crosscutting on the 2,700 ft. level of the Colorado mine has been reached, showing more than 20 ft. of first-class ore, that is, ore in which the copper content is 5 per cent or more.

Development work by North Butte has increased ore reserves somewhat the last quarter and with improved market conditions it is believed that the present tonnage can be increased.

Monthly shipments from the Crystal Copper Co.'s properties near Basin, Mont., and from the Goldsmith mine in the Butte district are amounting to eight cars. The orebody at the Goldsmith ranges from 18 in. to 7 ft., with the grade high, particularly in silver.

With more of the details coming to light in connection with the compromise reached between the Anaconda and the Elm Orlu over a disputed section of the Pilot-Butte, it appears that the former won something of a victory over the Anaconda, as vein territory of much richness in the Pilot Butte claim of the Anaconda passes to the Elm Orlu through the apexing of a vein in the Elm Orlu which, on dip, united with the Pilot-Butte fissure.

Elkhorn—Boston & Montana continues drifting in ore in the Blue Jay vein on the 300 ft. level. Several smaller veins have been opened carrying ore and the tonnage of milling rock appears to be increasing. Raising for the Park vein is in progress from the 300 level.

Troy—Merger of the Silver Tip Mining Co. with the Troy and the J. P. Lead companies is proposed. The three corporations hold 26 mining claims near Troy, Mont. Spokane interests are behind the proposed consolidation.

Boulder—Work has been resumed at the Robert Emmet and two well defined veins are being opened.

Comet District—Plans are under way by the Montana Cons. for a resumption of milling operations. A large tonnage of silver-zinc ore is available.

Champion District — Ground was broken by Butte Jardine last week for the construction of a 100-ton flotation plant, to cost an estimated $65,000. The flow sheet is so arranged as to permit of increasing the capacity to 200 tons. Timber to the amount of 135,000 ft. has been cut and the power and water lines are in. Since the latter part of June, first class ore to the amount of $16,000 has been shipped. A body of milling ore 351 ft. long with the ore still continuing has been officially reported. This shoot has an everage width of 5 ft. and grades about 18 oz. silver and $1.50 gold.

MICHIGAN

The Copper District

Seneca To Start Development of 5th Level

Houghton—The depression in the copper situation continues to influence adversely the condition of every copper mine in northern Michigan. Perhaps the worst feature is the psychological depression on the men employed in the mines and upon the business people of the community. The coal problem has been relieved to a considerable degree but the price paid for coal is simply another additional problem. The labor problem has been alleviated.

Additions to the cost of production cannot readily be met by Michigan copper mines. Under the circumstances the further increase in freight charges is embarrassing. Rates now will vary from 20 to 40c. a ton, depending upon the distance of the haulage. Two years ago the lowest rate was 10c. a ton and the highest 18 cents.

Calumet & Hecla's operations are now confined to the conglomerate lode and to the extraction of copper from the lake sands. But one shaft continues in operation on the Osceola lode. That is No. 15, No. 16 having suspended.

Mayflower's raise in the west crosscut is in over 70 ft. and fairly good vein matter has been showing for ten days. In the southerly drift, 160 ft. from the shaft, there is more vein matter.

Seneca's work at the Gratiot property has now reached a point 700 ft. to the south on the 13th level. The character of the formation indicates that it ought to run 25 lb. to the ton. For a distance of 200 ft. the Gratiot opening has been in rock of this grade. Practically all the way from the shaft the openings have been in average Kearsarge lode ore which may be mined and milled profitably under normal cost conditions.

Development of the 5th level at the Seneca is about to be started. The depth has been attained and the lateral tunneling to the lode will be under way within a few days. Then the raise to the level above will be driven and the drifts in the vein, both north and south, started. The 4th level south has reached the Ahmeek boundary. The 3rd and 4th levels have now been driven 670 ft. to the north and the only noted improvement has been in the general character of the ground in that direction. The conditions of the ground in the both levels on the south has been indicative of a lode formation that will compare favorably with that which was milled last spring. It is now planned to boost the tonnage to 2,000 daily as soon as the hoisting plans are completed to take care of such an output. The underground development of the average Lake copper mine is ordinarily away behind the equipment of the surface plant.

Menominee Range

Much Diamond Drilling Under Way in Crystal Falls Field

Crystal Falls—Considerable diamond drilling is being conducted in the Crystal Falls field at present, there being more drill outfits in operation than for some time past. New orebodies are being sought, but no results are obtainable. The Cleveland-Cliffs Iron Co. is again drilling on the lands in Sect. 12, 42-33. Ore was found here a few years ago, but sufficient work was not done at that time to prove the extent of the deposit. Oglebay, Norton & Co.

have two drill outfits going on their property in Sect. 24, 25 and 26, 43-33. The McKinney Steel Co. is making a geological survey of its properties on the range and it is likely that drilling will follow. B. C. Neely and associates have a drill in operation on Sect. 7, 42-32. This property has been drilled several times in years past, but the orebody has never been outlined in detail. J. M. Longyear has two drills working on the southward extension of the iron formation of the old Mansfield mine.

Gogebic Range (Including Wisconsin Section)

Mellen, Wis.—At the Berkshire mine near Mellen, Wis., at the western end of the Gogebic range, preparations are being made to resume operation. It is a low-grade, open-cut proposition, and the ore, though largely magnetic, is wet-concentrated with jigs after being crushed. The crushing is not so fine as to require sintering of the concentrates. At the same time this prevents obtaining concentrates of high iron content. If results can be obtained that are satisfactory, it will be of great interest to the district as there are undoubtedly large amounts of low-grade "ore" on the range which would be susceptible to similar treatment. The Gogebic iron range as known at present extends in an east and west direction about 55 or 60 miles, but the producing mines are all contained in the portion beginning at the middle of the range and extending eastward about 18 miles. The Berkshire is 18 miles west of this productive section, but if the concentration process proves successful in the long run, there will undoubtedly be other mines opened up in the section now regarded a barren of merchantable ore. At the eastern end of the productive section the Morgan mine is in the development stage, and eight miles east of that the Whitesides interests of Duluth are still drilling the old Presque Isle mine property.

Ironwood, Mich.—The steel headframe at the "H" shaft of the Pabst mine is about completed as far as the steel work goes.

The Newport mine has built a garage and a large stable, both of concrete.

The Tilden mine is to have an electric haulage system installed in No. 10 shaft; it will be a trolley system supplied from a rotary converter to be placed in the new engine house.

MINNESOTA

Hill-Trumbull Makes First Shipment—Washing Plant Going Up at Mariska Mine

Coleraine—The Hill-Trumbull mine of the Mesaba Cliffs Iron Co. has made its first shipment under the new ownership. It was opened by the Oliver Iron Mining Co. in 1909, but was surrendered at the time the Oliver surrendered all its Great Northern leases. In 1919 it was taken over by the present operators, who have continued the development of the open pit and have installed a one-unit washing plant that can handle 80 cars per shift to care for the siliceous ore. The shipment made was of merchantable ore but the washing plant will be running soon.

Construction of the Hill-Annex washing plant of the Interstate Iron Co., adjoining the Hill-Trumbull, is progressing. Structural steel is practically all in place and the half-mile approach, which has been built of overburden stripped in opening the mine, has been completed. The Hill-Annex has a reserve of approximately 22,000,000 tons, wash and merchantable.

Gilbert—Work is progressing rapidly on reopening the old Mariska mine. Bowe-Burke Co. are the new operators and J. C. Hartness of the Eveleth is in charge. Erection of a small washing plant to serve the mine is under way. It will be the first installation of its kind in the immediate vicinity.

Pickands, Mather & Co. has started to deepen No. 2 shaft at the Corsica mine. It will be deepened about 100 ft. to develop the lower area of the orebody.

ALABAMA

Birmingham Ore Mining Co.'s Washing Plant Near Completion

Birmingham—The recent cargo of manganiferous iron ore brought up from Brazil, via Mobile, is now being delivered to bins and stacks in the yards of the Tennessee Coal, Iron & R.R. Co. at its Ensley plants. Some of it is being brought up the Warrior River on the Government-owned and operated barge lines and some by railroad. There is about 7,500 tons of ore to be moved and it is understood that shipments will continue. Furnaces are desirous of getting a good supply of ore on hand and are making heavy demands on the railroads. Preparations are being made for winter. Reports from the ore mines throughout the district indicate that colored labor which wandered north is gradually returning.

The Sloss-Sheffield Steel & Iron Co. is making some investigations looking to the development of ore deposits around Compton, about 20 miles north of Birmingham. The vein is rather thin but if the demand warrants may be profitably worked.

The Birmingham Ore & Mining Co. will complete its jigging plant in the next fortnight at the Helen Bess mines, on Red Mountain, not far from the heart of Birmingham and will then wash all the ore mined there. Construction was begun months ago but met with delay. It has already been in partial operation.

JOPLIN-MIAMI DISTRICT

Oklahoma-Kansas-Missouri

Tampa Company To Seek Deeper for Better Ore—Hawkins, at Hockerville, Buys Mill

Baxter Springs, Kan.—Although getting all ore from its No. 3 shaft, the Lucky Jew Mining Co. is drifting at No. 1 shaft and sinking at No. 2. The mine, which is eight miles west of Baxter and at the extreme northwestern point of development of the Miami-Picher-Baxter field, was long considered a doubtful proposition by most mining men. Recently it has developed into a steady producer, the average recovery being approximately 11 per cent (in local terms), the company making about 30 tons of concentrates daily, operating the mill single shift. Drifting and sinking now under way at the No. 1 and No. 2 shafts are for the purposes of tapping lead runs indicated by drilling. A very fair percentage of the concentrates now being made are lead of a premium grade. The zinc concentrates also average from 61 to 62 per cent metallic zinc. Operations are conducted at a depth of 320 ft. at the No. 3 shaft, and at slightly shallower depths at the two others. W. C. Bowman is president and M. G. West secretary and manager, both being from Kansas City, Mo. H. Stout is superintendent.

The U. S. Smelting Co. is completing the sinking of a shaft one-half mile west of its No. 2 mill, near Baxter, not far from the Lucky Jew property. The shaft was put down in a lime bar, but heavy water was tapped only a few feet from the bottom, which is at the 320 ft. level. One 3-in. and one 7-in. steam pump have been installed and another will follow. Good lead cuttings have come up in the water but exploration has been impossible. It is planned to connect the shaft with a surface railroad that probably will tap one or two other shafts between this one and the mill. D. R. Muir, Baxter, Kan., is manager.

The Tampa Mining Co. is planning to sink, expecting to find better ore. It is now working at 265 ft. and surrounding mines have ore at 300 ft. and below. This company recently spent $3,000 to drain the water at one of its shafts, preparatory to sinking, only to have its activity stopped by lack of coal. G. C. Warner, recently of Tampa, is principal owner.

Picher, Okla.—The Huttig L. & Z. Co. has completed the first of four field shafts that will be put down between its No. 1 and No. 2 mills northwest of Picher. Dirt from this new shaft will be taken to No. 2 mill over the surface road, for which an 11-ton Davenport locomotive was recently delivered. The site for a second field shaft has been located and sinking begun. Ore from it also will go to No. 2 mill, as well as from the third shaft. Ore from the fourth field shaft will be carried to No. 1 mill by an incline tramway. This plan will obviate the necessity of the company taking its surface railroad across the tracks of the Southwest Missouri interurban railroad. The first field shaft has gone into good ore.

Hockerville, Okla.—The Hawkins Mining Co., which recently discovered a rich deposit of lead ore on a lease just south of town, has purchased a concentrator at Sunnyside, three miles distant, and is moving it to the mine. The mine continues to be a big lead producer. One chunk of ore weighing about 1,000 lb. will be sent to the Missouri State Fair at Sedalia.

THE MARKET REPORT

Daily Prices of Metals in New York

Aug.	Copper	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
26	18.10@18.30	43.00	46.75@47.00	8.50	8.60@8.75	7.90@7.95
27	18.10@18.30	43.50	47.00@47.50	8 40	8.75	7.90@7 95
28	18.10@18.30	43.50	47.00@47.50	8.35	8.75	7.85@7.95
30	18.10@18.30	43.00	46.25@46.75	8.35	8.75	7.85
31	18.10@18.30	42.50	45.50@45.75	8.35	8.50@9.00	7.85
Sept. 1	18.10@18.30	42.50	45.50@45.75	8.35	8.50@9.00	7.85

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point. All prices are in cents per pound.

Copper is commonly sold on terms "delivered," which means that the seller pays the freight from refinery to buyer's destination. The delivery cost varies, and it would be confusing to figure net prices on individual transactions. Consequently, an average deduction of 0.15c. is made from the "delivered" price, to arrive at the New York price. When copper is sold f.o.b. or f.a.s. New York, of course no deduction is made.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Aug.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
26	93¾	95¼	111	269½	278	35¾	35⅞	39¾	41½
27	94¼	95¾	111	274¾	282¼	35⅞	36	40	41½
28	....	....	...	....	....	....	....	....	..
30	94¾	96	111	273	281½	36½	36¾	40	41½
31	95	96¼	111	272	279	36⅝	36¾	39½	41
Sept. 1	95	96¼	111	269½	276	36½	36½	39¼	40½

The above table gives the closing quotations on the London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Aug.	Sterling Exchange	Silver			Aug.	Sterling Exchange	Silver		
		New York, Domestic Origin	New York, Foreign Origin	London			New York, Domestic Origin	New York, Foreign Origin	London
26	357½	99½	98	61⅛	30	355	99½	94½	59⅝
27	357½	99½	97¾	61	31	354½	99½	92¾	58¾
28	356	99½	97⅛	60⅝	Sep 1	356	99½	91½	57⅝

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

On the authority of the Secretary of the Treasury, we quote 100c. per oz. for silver, 1,000 fine, delivered at the option of the Director of the Mint to the New York Assay Office or to the mints in Philadelphia, Denver, or San Francisco, and proved to the satisfaction of the Treasury Department to have been mined, smelted, and refined in the United States. This quotation is retroactive to May 13.

Metal Markets

New York, Sept. 1, 1920

Price changes since last week have been of little importance. Sales of metal for August have generally been light, with the exception of lead, for which a good demand has existed. Low prices in London are acting as a brake on the metal market here.

Copper

No buying of importance is yet taking place at anything like the prices which the large producers are asking, viz. 18¾@19c. delivered. A few lots are being marketed at about 18¼c. delivered, but should the demand pick up this price is almost certain to increase. It is the general opinion that September will see a real buying movement, and that the average price will be at least ½c. above that at which copper can now be had. Fundamental conditions are good.

Lead

A peculiar situation exists in the lead market. The A. S. & R. contract price continues at 9c., New York, and considerable metal is sold on this basis. On the other hand, lead can be imported from Europe and sold at a profit here at 8¼c. It is understood that 300 tons is on the dock here looking for a buyer at that price. This European lead is, in general, good Mexican and Australian brands. We quote prompt lead, New York, for the week at 8.25@8.50c., and forward delivery, 7.85@8.25c.

The dearth of lead in the Middle West and the fact that large quantities are being imported at New York for western delivery have caused the St. Louis price to rise above that quoted in the East. This is an unusual situation, which will continue until consumption slackens, or until domestic production is able to supply the demand. Small lots of favored brands for September shipment are commanding 9c. in St. Louis today, though some metal is being offered at ¼@½c. under this.

Zinc

Producers have been compelled to reduce their prices to 7.85c. to meet European competition. Even at this price some arguments have to be used to induce consumers to buy the domestic product, such as the fact that the brands are well known, as are the producers, and there will be no uncertainty as to shipment. Heretofore, we have quoted the New York price of zinc at 35 points above the St. Louis price, but in view of the abnormal conditions now existing, we quote, on Sept. 1, the New York price equal to the St. Louis price, 7.85c.

Tin

Some optimism was shown Thursday and Friday when the London market took a little spurt, but this week tin sellers are as doleful as ever, and report almost a total lack of business. The 99 per cent grade was depressed all of last month by the presence of about 1,300 tons of Chinese tin. Rarely has the tin market had a more quiet month.

Monthly Average Prices for August

Copper:	
New York Electrolytic	18.346
London Standard	93.935
London Electrolytic	111.143
Lead:	
New York	8.687
St. Louis	8.725
London	36.304
Silver:	
New York, foreign	96.168
New York, domestic	99.673
London	59.875
Sterling Exchange	360.404
Zinc:	
New York	8.185
St. Louis	7.835
London	41.220
Tin:	
99 per cent	43.856
Straits	47.620
London	274.048
Antimony	7.177
Quicksilver	83.806

Straits tin for future delivery: Aug. 26th, 46.75@47.25; 27th, 47.50@48.00; 28th, 47.50 @ 48.00c.; 30th, 46.25 @ 46.75c.; 31st, 45.75@46.00c.; Sept. 1st, 45.50@45.75c.

Arrivals of tin in long tons: Aug. 26th, China, 20; 27th, Liverpool, 75; 28th, Singapore, 200.

Silver

The silver market ruled steady and firm on China buying until Aug. 30. The London market was then demoralized by weakness in Indian exchange and continued sales by the bazaars. Supplies of foreign silver in our market continue limited and as the U. S. Treasury is buying all the Domestic output, exports to London are nil and only moderate amounts are available for China shipments.

Mexican Dollars—Aug. 26, 75; 27th, 74¼; 28th, 74¼; 30th, 71⅞; 31st, 70¼; Sept. 1, 69½.

Gold

Gold in London on Aug. 26th, 115s.; 27th, 115s.; 30th, 115s. 5d.; 31st, 115s. 6d.; Sept. 1st, 115s. 1d.

Foreign Exchange

Yesterday francs were 6.97c.; lire, 4.67c.; and marks, 2.05c. New York funds in Montreal declined to 11⅝ per cent premium, probably due to the commencement of exportation of this year's grain. Only slight changes characterized the exchange market during the last week.

Other Metals

Aluminum—Ingot, 99 per cent and purer, 35.1c.; 98@99 per cent, 34.9c. Virgin metal still obtainable in open market at about 32.5c. for 98@99 grade.

Antimony—Market continues weak. Spot, 7c. per lb.; Cookson's "C" grade, 14@15c. Chinese and Japanese brands, 7c. W. C. C. brand, 9@9½c. [1]Chinese needle antimony, lump, firm at 8@9c. per lb. Standard powdered needle antimony (200 mesh), 10@12c. per lb.

Bismuth—$2.70 per lb., 500-lb. lots, and $2.72 per lb., 100-lb. lots. Market quiet.

Cadmium—Nominal, $1.40@$1.50 per lb. Market steady.

Cobalt—Metal, $3 per lb.; black oxide, $2 per lb.

Iridium—Nominal, $350 per oz. Heavy demand, but small supplies.

Magnesium—Crude, 99 per cent or over pure, $1.75 per lb., for the metal in 100 lb. lots and over, f.o.b. Niagara Falls.

[1]**Molybdenum Metal** in rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Ingot, 43c.; shot, 43c.; electrolytic, 45c., f.o.b. Bayonne, N. J.; Monel metal, shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—Open market, $50@$75 per troy oz.

Palladium—$100@$110 per oz.

Platinum—Firm at $115@$120 per oz. $105 per oz. in 100 oz. lots.

Quicksilver—Market quiet; $75 per 75-lb. flask. San Francisco wires $75. Barely steady.

Ruthenium—$200@$220 per troy oz.

[1]**Selenium**, black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb. Demand strong.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $20 per lb.

Metallic Ores

Bauxite—About 52 per cent alumina content, less than 2 per cent iron oxide, up to 20 per cent silica and artificially dried to contain not more than 4 per cent free moisture, $10 per gross ton at mine; 54 per cent alumina and about 15 per cent silica, $11; averaging 57 per cent alumina, 8 to 12 per cent silica, less than 3 per cent iron oxide, $13 on basis of 8 per cent free moisture. Ores of very low silica content suitable for the manufacture of aluminum oxide and hydrate of alumina command a fancy price.

Chrome Ore—Guaranteed 50 per cent Cr_2O_3 foreign ore with a minimum of 6 per cent silica, 80@85c. per unit, New York. California concentrates, 50 per cent Cr_2O_3 and upward, 70@75c.

Iron Ores—Lake Superior ores, per ton, delivered at Lower Lake ports: Old Range bessemer, $7.45; Old Range non-bessemer, $6.70; Mesabi bessemer, $7.20; Mesabi non-bessemer, $6.55. Congestion at Lake Erie ports due to car shortage has resulted in decreased tonnage. The ore movement is better than at any previous time this season.

Manganese Ore—70@80c. per unit, 50 per cent Mn content, c.i.f. Atlantic seaport; chemical ore (MnO_2) $75@$85 per gross ton.

Molybdenum ore—85 per cent MoS_2, 75@80c. per lb. of contained sulphide, New York.

[1]**Tantalum Ore**, guaranteed minimum 60 per cent tantalic acid, 55@65c. per lb. in ton lots, against recent price of 65@70c.

Titanium Ores—Ilmenite[1], 52 per cent TiO_2, 1¼@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 15c. per lb. for ore, with concessions on large lots or running contracts.

Tungsten Ore—Scheelite, 60 per cent WO_3 and over, per unit of WO_3, $7 f.o.b. mines; wolframite, 60 per cent WO_3 and over, per unit of WO_3, $6@$7, in New York.

Uranium Ore (Carnotite)—$2.75@$3 per lb. for 96 per cent of the contained oxide (U_3O_8). Ores must contain a minimum of 2 per cent U_3O_8.

Vanadium Ore—$1.25 per lb. of V_2O_5 (guaranteed minimum of 11 per cent V_2O_5), New York.

[1]**Zircon**—Washed, iron free, 5c. per lb.

[1]**Zirkite**—$90@$100 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

[1]Furnished by Foote Mineral Co., Philadelphia, Pa.

Zinc and Lead Ore Markets

Joplin, Mo., Aug. 28—Zinc blende, per ton, high $52.70; basis 60 per cent zinc, premium $48.50; Prime Western, $47.50; fines and slimes, $45@$42.50. Calamine, basis 40 per cent zinc, $36. Average settling prices: Blende, $47.16, calamine, $38.18; all zinc ores, $47.12.

Lead, high, $110.25; basis 80 per cent lead, $110; average settling price, all grades of lead, $104 per ton.

Shipments for the week: Blende, 13,591; calamine, 33; lead, 2,121 tons. Value, all ores the week, $862,870.

A total of 295 carloads of blende were shipped at an average of 46.2 tons per car. The larger tonnage is being shipped in coal cars, as few box cars are provided.

Platteville, Wis., Aug. 28—Blende, basis 60 per cent zinc, $52.50 per ton for high grade. Lead ore, basis 80 per cent lead, $105@$110 per ton. Shipments for the week: blende, 1,373; lead, 60 tons. Shipments for the year: blende, 47,143; calamine, 2,330; lead, 3,900; sulphur ore, 1,209 tons. Shipped during week to separating plants, 2,107 tons blende.

Non-Metallic Minerals

Asbestos—Crude, No. 1, $2,400@$3,000; No. 2, $1,400@$1,700; spinning fibres, $400@$800; magnesia and compressed sheet fibres, $325@$400; shingle stock, $110@$150; paper stock, $60@$75; cement stock, $17.50@$30; floats, $8.50@$15, all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines, Quebec, Canada; 5 per cent to be added as Canadian royalty export sales tax. Freight rate from mines to Sherbrooke, Quebec, over Quebec Central R.R., 20c. per cwt.; from Sherbrooke to New York, 27½c., carload lots; freight to New York for crude No. 1, f.o.b. Thetford mines, $8.45 per ton, carload lots. Market very strong, owing to heavy demand and a production that is 25 per cent below normal. Higher prices for all grades of material are expected soon.

Barytes—Crude, 88 to 94 per cent barium content, $10@$12 per net ton; ground (white) $24@$30 in bags, carload lots; (off-color) $22@$26 in bags, carload lots; all f.o.b. Kings Creek, S. C. Crude, 88 to 94 per cent, $12 per gross ton; ground (white) $23@$25; ground (off color) $16@$19 per net ton, f.o.b. Cartersville, Ga. Crude, 88 to 94 per cent, $23; ground (white) $40.50; ground (off color) $27 per net ton, less than carload lots, f.o.b. New York. Crude, not less than 98 per cent, $11@$11.25 per ton, f.o.b. cars, Missouri; floated, $28 per ton in bbls.; $26.50 per ton in 100-lb. bags; extra charge for bags, f.o.b. St. Louis.

Chalk—Domestic, extra light, 5@6c. per lb.; light, 4½@5½c.; heavy, 4@5c; English, extra light, 5@7c.; light, 5@6c.; dense, 4½@5c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, $9@$12; washed, $12@$15; powdered, $18@$22; bags extra, per net ton, f.o.b. mines, Georgia; crude, $8@$12; ground,

$15@$40, f.o.b. Virginia points. Domestic lump, $10@$20; powdered, $25@$30; imported lump, $25@$35; powdered, $30@$60, f.o.b. New York.

Feldspar—Crude, $8@$18 per gross ton, f.o.b. Maryland and North Carolina points; $7.50@$10, f.o.b. Maine; ground, $25@$30 car lots, f.o.b. Baltimore; ground, $17@$20, f.o.b. North Carolina points; $17@$20 per ton, No. 1 ground, f.o.b. New York State; $21@$23 per ton, ground, f.o.b. Maine.

Fluorspar — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $25 per ton, f.o.b. Illinois mines, and $27.50, f.o.b. Kentucky; ground, suitable for acid, chemical or enameling purposes, $60; lump, $17.50, f.o.b. Tonuco, N. M.

Graphite—Crucible flake, 85 per cent carbon content, 8c. per lb.; 88 per cent, 9½c.; 90 per cent, 10½c., all f.o.b. New York. Crucible grades of Alabama graphite sell as follows, f.o.b. Ashland, Ala.: 80 per cent, 5c.; 90 per cent, 10c. Lubricating grades in increasing demand, with price ranging from 11c. for the 85 per cent guaranteed grade in car lots to 30 and 40c. for higher grades. Mexican, amorphous, $45@$55 per short ton; Korean, 3½c. per lb.; Madagascar, 8c.; Ceylon, 4½@15½c.

Gypsum—Raw crushed rock, $3.50@$4 per ton; raw ground fine, $4@$4.50; calcined stucco, $9, all f.o.b. works. Containers extra. The last price quoted for plaster of paris in carload lots was $4.25 per 250-lb. bbl., alongside dock, New York; but a new price, not yet made public, will soon be effective.

Kaolin—See China Clay.

Limestone—Dolomite, 1@2 man size, $1.60@$1.65; 2@8 in., $1.55@$1.65 per net ton, f.o.b. Plymouth Meeting, Pa.; fluxing, $1.65@$1.75 per net ton, f.o.b. Howellville, Pa.

Magnesite. Calcined — High-grade caustic calcined, lump form, $35@$40 per ton, carload lots, f.o.b. California points. Freshly ground calcined, suitable for flooring trade, $65@$75 per ton, f.o.b. Eastern points.

Dead-Burned — $32.50 per net ton, Chewelah, Wash.; $52@$58, Chester, Pa. Austrian grade, $52@$55 per ton, f.o.b. Baltimore. (Magnesite brick—See Refractories.)

Mica—Imported block mica slightly stained, per lb.: No. 6, 50c.; No. 5, $1.20@$1.40; No. 4, $2@$3; No. 3, $4.25@$5; No. 2, $5.50@$7; No. 1, $8. Clear block: No. 6, 55c.; No. 5, $2; No. 4, $4; No. 3, $5.75; No. 2, $7; No. 1, $9; A1, $14; extra large, $25, all f.o.b. New York; ground, $85@$100 per ton, Philadelphia.

[1]**Monazite** — Minimum of 6 per cent thorium oxide, $35 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports: 77 per cent tricalcium phosphate, $13; 75 per cent, $11.50; 75@74 per cent, $11; 70 per cent, $8.35; 68 per cent, $7.85; 68@66 per cent, $7.60. There is no price schedule for spot for domestic uses.

Pumice Stone—Imported, lump, 4@50c. per lb.; domestic lump, 6c.; ground, 4@7c., all f.o.b. New York.

Pyrites—Spanish, fines, per unit 12c., c.i.f. Atlantic seaport; furnace size, 17½c.; run of mine, 12@14c.; domestic, fines, f.o.b. mines, 12@14c.

Quartz—(Acid tower) fist to head, $10; 1¼ to 2 in., $14; rice, $17, all net ton, f.o.b. Baltimore; lump, carload lots, $5@$7.50 net ton, f.o.b. North Carolina mines. F.o.b. Wausau, Wis., the price is $16 per ton in car lots, and $22 less quantities, including bags.

Sulphur—$18 per ton for domestic; $20 for export, f.o.b. Texas and Louisiana mines.

Talc — Paper making, $10@$20 per ton; roofing grades, $9@$15; rubber grades, $10@$15, all f.o.b. Vermont. California talc, $20@$45, talcum powder grade. Southern talc, powdered, carload lots, $15@$20 per ton; less than carload, $25, f.o.b. cars; freight to New York $5.25 per ton, carload lots; less than carload lots, $9.25. Imported, $60@$70; Canadian, $20@$40 per ton.

Mineral Products

Arsenic—White arsenic, 15½c. per lb.; sulphide, powdered, 20@21c. per lb., f.o.b. works, carload lots.

Nitrate—Soda, $3.85 per cwt., ex vessel, Atlantic ports. Market quiet.

Potassium Sulphate—Domestic, $2.25@$2.50 per net ton, basis 90 per cent, f.o.b. New York.

Ferro Alloys

Ferrocarbontitanium—For 15-18 per cent material, $200@$250 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12 to $15. Foreign conditions as affecting the price of American goods remain unchanged.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 17@18c. per lb. of chromium contained; 4 to 6 per cent carbon, 19@20c. f.o.b. works.

Ferromanganese—For 76 to 80 per cent, prompt delivery, $200@$210, freight allowed; last half, $170; English, $190@200, c.i.f. Atlantic seaports. Spiegeleisen, 18@22 per cent, $80@$85, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2.50@$3 per lb. of contained metal, f.o.b. works.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $60@$65; 50 per cent, $80@$85; 75 per cent, $150@$160.

Ferrotungsten—70 to 80 per cent W, $1.10@$1.15 per lb. of contained tungsten, f.o.b. works.

Ferro-uranium—35 to 50 per cent U, $7 per lb. of U contained, f.o.b. works.

Ferrovanadium—Basis 30 to 40 per cent, $6.50@$9.50 per lb. of V contained, f.o.b. works.

Metal Products

Copper Sheets — Current New York price, 29½c. per lb.; wire quoted, 22½@23c.

[1]Furnished by Foote Mineral Co., Philadelphia, Pa.

Lead Sheets—Full lead sheets, 11c.; cut lead sheets, 12½c. in quantity, mill lots.

Nickel Silver—Unchanged at 39½c. per lb. for 18 per cent nickel.

Yellow Metal — Dimension sheets, 26⅜c.; sheathing, 25⅜c.; rods, ⅜ to 3 in., 23⅜c.

Zinc Sheets—$12.50 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter; zinc plates, 12c. per lb.

Refractories

Bauxite Brick—56 per cent alumina, $160 per 1,000, f.o.b. Pittsburgh.

Chrome Brick—$100@$110 per net ton, carload lots, eastern shipping points.

Chrome Cement—40 to 45 per cent Cr_2O_3, $50 per net ton, and $55 in sacks, carload lots, eastern shipping points.

Clay Brick — First-quality fire clay, 9-in. shapes, $55@$60 per 1,000, Pennsylvania, Ohio, and Kentucky works; second quality, $50@$55. First quality, St. Louis, $45; New Jersey, $75.

Magnesite Brick—$110@$120 per ton, eastern shipping points; 9-in. straights, $90@$100; 9-in. arches, wedges and keys, $95@$105; soaps and splits, $110@$120.

Silica Brick—9-in. per 1,000, $56@$61, Birmingham, Ala.; $55@$60, Mount Union, Pa.; $65, Chicago district.

Iron Trade Review

Pittsburgh, Aug. 31, 1920

The continued stagnation in the steel market is having its effect on some producers, leading them to plan curtailments in production, but no effect upon prices, which are stiffly maintained. This is in line with pre-war experience, when sellers felt that to reduce prices would be to discourage buying. Such demand for steel products as exists is for early deliveries, and for such deliveries steel is still scarce. The practical ending of the midsummer period, normally dull, with the market grown still duller nevertheless, is regarded in some quarters as ominous.

Transportation conditions continue to improve and are likely to be practically normal within a few weeks.

Pig Iron—Actual market prices on bessemer and basic have been developed by a few transactions totaling only a few thousand tons, at $48 Valley, for both grades, previous market prices having been $47 and $46.50, respectively. Foundry remains at $50, Valley, to which level it recently advanced. Inquiry for all grades is very light and there is likely to be a deadlock for some time.

Steel—There is only occasional demand for billets, chiefly from brokers, and sheet bar demand has become light, but mills show relatively little disposition to shade prices. We quote billets at $60 and sheet bars at $67.50.

Charcoal and Coke

Charcoal—Willow, 7c. per lb. in bbls.; hardwood, 6c. per lb., in 250-lb. bbls.

Connellsville — Furnace, $20@$22; foundry, $23@$24.

COMPANY REPORTS

Alaska Gold Mines Co.

Gold; Alaska

The following is a comparative summary of results of mining and milling of the Alaska Gastineau Mining Co. for the periods indicated:

	Second Quarter 1920	First Quarter 1920
Tons milled	537,754	625,890
Gross value	$0.85	$0.84
Yield per ton	.68	.66
Tails per ton	.17	.18
Extraction	79.39%	79.16%
Value recovered	$0.68	$0.66
Operating expenses, less miscellaneous income	$0.79	$0.79
Loss per ton	$0.11	$0.13

During the quarter 646,327 tons of ore was broken in the mine and 535,874 tons trammed to the oreways, as compared with 561,358 tons broken and 627,451 tons trammed during the previous quarter. Of the amount trammed about 41.6 per cent represented excess ore drawn from the caved stopes. The transportation division operated satisfactorily throughout the quarter. A total of 537,754 tons of ore was milled, compared with 625,890 tons for the previous quarter.

The gross value of ore delivered to the mill during the quarter averaged $0.854 per ton, or an increase over the first quarter of $0.019. Operating expenses, less miscellaneous income, amounted to $0.79 per ton, as compared with $0.79 per ton for the previous period. The miscellaneous income showed a net loss of $10.67, the loss sustained in the operation of the company's boarding houses having been in excess of the amount received from the sale of power.

The following statement compares the operating results:

	Second Quarter 1920	First Quarter 1920
Revenue:		
Gross value of bullion and concentrates produced	$364,866.48	$413,246.04
Expenses:		
Ore production and transportation	$237,696.86	$285,406.01
Milling	150,980.00	172,441.83
Shipping and smelting charges	15,339.45	17,572.48
Administration and general expense	22,520.62	22,410.60
Total operating expenses	$426,536.95	$497,830.92
	$61,670.45*a*	$84,584.88*a*
Miscellaneous income	10.67*a*	2,966.94
Operating loss	$61,681.12	$81,617.94

(a) Loss.

Included in costs in the above statement are prepaid development items representing costs of breaking and preparing ore in previous periods, which have been carried on the books as deferred charges. Consequently, although the above operating statement shows a loss after including these charges, the actual cash receipts and disbursements for the period reflect a cash gain of $8,603.46.

International Nickel Co.

Nickel; U. S. and Canada

The consolidated general profit and loss statement of the International Nickel Co. for the three months ending June 30, 1920, follows:

Earnings		$2,172,097.06
Other income		272,208.32
Total income		$2,444,305.38
Administration and general expense	$160,651.38	
Reserved for U. S. and foreign taxes (estimated)	306,973.33	467,624.71
Net income		$1,976,680.67
Depreciation and mineral exhaustion		574,611.74
Profits		$1,402,068.93
Dividends		
Preferred No. 59, payable Aug. 2, 1920		133,689.00
Balance		$1,268,379.93

Union Miniere du Haut-Katanga

Copper; Congo Free State

The report of the Union Minière du Haut-Katanga for the year 1919 indicates that seven copper mines were regularly in operation during that year, producing 876,000 tons of ore suitable for direct smelting and 316,000 tons of ore unsuitable for that purpose. The output of smelted copper amounted to 23,028 tons, against 20,238 tons in 1918. The number of native workmen increased from 6,000 in 1918 to 12,000. The average producing price per metric ton c.i.f. European ports was 2,500 fr., not taking into account the charges arising through the transfer of the company's office from Antwerp to London during the war and its becoming liable to British income and other taxes thereby. The copper production during the first six months of 1920 was affected by strikes on the railways connecting Katanga with Beira, and only amounted to 10,251 tons.

New Jersey Zinc Co.

Zinc; New Jersey

A statement of the New Jersey Zinc Co. for the quarter ending June 30, 1920, follows:

Income (including dividends from subsidiary companies) after deductions for expenses, taxes, maintenance, repairs and renewals, betterments, depreciation and contingencies		$3,341,576.98
Deduct interest on first mortgage bonds	$ 40,000.00	
Reserve for retirement of bonds	75,000.00	
Reserve for federal taxes	470,000.00	585,000.00
		$2,756,576.98
Dividends		
Quarterly, 4 per cent: Payable Aug. 10, 1920		1,680,000.00
Surplus for the quarter		$1,076,576.98

Cerro Gordo Mines Co.

Silver, Lead, Zinc; California

The fourth annual report of the Cerro Gordo Mines Co. for the year 1919 indicates that 357 tons of lead-silver ore, of a net smelter value of $26.21 per ton; 167 tons of zinc ore, with a net smelter value of $12.45 per ton; 159 tons of slag worth $3.92 per ton—a total of $12,060.66—were produced. Operations for the year resulted in a deficit of $26,481.27, and were abandoned in June, 1919.

August Mining Dividends

The following is a partial list of mining dividends paid during August, 1920:

U. S. Mining and Metallurgical Companies.	Situation.	Per Share.	Totals.
Am. Zn. Ld. & Sm., pfd.	U. S.	$1.50q	$120,810
Anaconda Copper Min., c, s, z	Mont.	1.00q	2,331,250
Barnes-King Develop., g	Mont.	1.05q	20,000
Gemini, g, s	Utah	6.00k	30,000
Internat. Nickel, pfd.	U. S.-Can.	1.50q	133,689
Miami Copper Co.	Ariz.	0.50q	373,557
Mohawk Mining Co., c	Mich.	1.50q	150,000
New Cornelia Copper Co.	Ariz.	1.25q	450,000
New Jersey Zinc Co.	U. S.	4.00q	1,680,000
United Verde Ext., c	Ariz.	0.50q	525,000
Canadian, Mexican, Central and and South American Companies			
Amparo Mining, g, s	Mex.	0.05qx	100,000
Conlagas Mines, Ltd., s	Ont.	0.12½q	100,000
Greene-Cananea Copper	Mex.	0.50	250,000
Hollinger Consol. Gold	Ont.	0.05bi-m	246,000
Ouro Preto Gold	Brazil	1sh., s-a	£1,358.05
Holding Companies.			
General Development Co.	U. S.	0.50k	60,000

m, monthly; q, quarterly; s-a, semi-annual; k, occasional; x, includes an extra dividend.

Greene-Cananea Copper Co. resumed dividends on Aug. 23, the first payment since February, 1919.

Bankers Trust Co., New York City, declared its readiness to pay the initial dividend of $1.35 on the "American shares" of Rand Mines, Ltd., on Aug. 27.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York			London		
	1918	1919	1920	1918	1919	1920
January	88.702	101.125	132.827	44.356	48.438	79.846
February	85.716	101.125	131.295	42.792	48.027	85.005
March	88.082	101.125	125.551	43.620	48.171	74.194
April	95.346	101.125	119.779	47.215	48.886	68.848
May	99.505	107.135	102.585	48.980	52.104	60.010
June	99.500	110.430	90.957	48.875	53.896	51.096
July	99.625	106.394	91.971	48.813	54.133	53.736
August	100.292	111.370	96.168	49.077	58.835	59.875
September	101.125	114.540	.....	49.500	61.668	.....
October	101.125	119.192	.....	49.500	64.049	.....
November	101.125	127.924	.....	48.969	70.065	.....
December	101.125	131.976	.....	48.492	76.432	.....
Year	96.772	111.122	.....	41.516	57.059	.....

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York Electrolytic		London Standard		London (*b*) Electrolytic	
	1919	1920	1919	1920	1919	1920
January	(*a*)	18.918	92.238	118.095	106.619	123.238
February	16.763	18.569	78.700	120.188	95.700	126.950
March	14.856	18.331	76.821	109.533	82.071	118.348
April	15.246	18.660	77.300	103.025	82.200	111.500
May	15.864	18.484	77.767	96.750	81.227	109.200
June	17.610	18.065	83.062	87.864	85.900	101.909
July	21.604	18.576	99.576	90.148	103.046	106.455
August	22.319	18.346	97.300	93.935	106.429	111.143
September	21.755	.....	100.767	.....	.....	.....
October	21.534	.....	103.418	.....	.....	.....
November	19.758	.....	98.894	.....	.....	.....
December	18.295	.....	103.708	.....	.....	.....
Year	18.691	.....	90.796	.....	.....	.....

(*a*) No market. (*b*) See note on page 499.

Lead

	New York		St. Louis		London	
	1919	1920	1919	1920	1919	1920
January	5.432	8.561	5.316	8.300	37.227	47.095
February	5.057	8.814	4.784	8.601	28.675	50.256
March	5.226	9.145	4.992	8.894	27.952	46.054
April	4.982	8.902	4.722	8.618	24.888	39.225
May	5.018	8.576	4.773	8.352	23.852	38.488
June	5.340	8.323	5.070	8.169	22.544	34.330
July	5.626	8.338	5.408	8.783	23.457	34.963
August	5.798	8.687	5.583	8.725	25.330	36.304
September	6.108	.....	5.853	.....	28.473	.....
October	6.487	.....	6.249	.....	34.731	.....
November	6.808	.....	6.649	.....	41.202	.....
December	7.231	.....	6.955	.....	.....	.....
Year	5.759	.....	5.530	.....	28.590	.....

Tin

	New York 1919		New York 1920		London	
	99%	Straits	99%	Straits	1919	1920
January	67.702	.....	61.596	.....	248.557	376.512
February	66.801	.....	58.466	59.932	223.963	395.750
March	67.934	.....	61.037	61.926	236.843	369.489
April	72.500	.....	61.120	62.115	225.275	345.450
May	72.500	.....	53.230	55.100	234.398	294.813
June	71.240	.....	46.125	48.327	238.263	250.614
July	68.000	.....	45.798	49.154	253.272	261.886
August	57.226	.....	43.856	47.620	273.625	274.048
September	54.482	.....	.....	.....	280.102	.....
October	54.377	.....	.....	.....	279.239	.....
November	53.307	.....	.....	.....	283.556	.....
December	53.870	.....	.....	.....	314.113	.....
Year	63.328	.....	.....	.....	257.601	.....

Zinc

	New York		St. Louis		London	
	1919	1920	1919	1920	1919	1920
January	7.272	9.483	6.922	9.133	56.045	58.643
February	6.623	9.058	6.273	8.708	46.150	61.338
March	6.500	8.881	6.150	8.531	38.500	53.467
April	6.465	8.534	6.114	8.184	36.118	47.388
May	6.429	7.938	6.079	7.588	35.477	45.088
June	6.901	7.815	6.551	7.465	36.763	41.193
July	7.873	8.070	7.523	7.720	41.815	41.886
August	7.789	8.185	7.160	7.835	39.338	41.220
September	7.510	.....	7.473	.....	40.955	.....
October	7.823	.....	7.827	.....	43.630	.....
November	8.177	.....	8.350	.....	46.588	.....
December	8.700	.....	8.350	.....	53.101	.....
Year	7.338	.....	6.988	.....	42.879	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Pig Iron, Pittsburgh

	Bessemer ‡		Basic ‡		No. 2 Foundry	
	1919	1920	1919	1920	1919	1920
January	$33.60	$40.47	$31.40	$39.88	$32.40	$39.86
February	33.60	42.954	31.40	42.61	32.40	43.40
March	32.54	43.40	31.40	42.90	29.12	43.40
April	29.35	43.72	27.15	44.22	28.15	43.90
May	29.35	44.003	27.15	44.885	28.15	45.36
June	29.35	44.89	27.15	45.41	28.15	46.40
July	29.35	47.21	27.15	47.42	28.15	46.56
August	29.35	.....	27.15	.....	28.15	.....
September	29.35	.....	27.15	.....	28.15	.....
October	29.35	.....	27.15	.....	28.30	.....
November	31.60	.....	31.56	.....	32.16	.....
December	36.57	.....	35.32	.....	36.86	.....
Year	$31.11	.....	$29.26	.....	$28.35	.....

‡ As reported by W. P. Snyder & Co.

Antimony, New York; July, 7.500c., August, 7.177c.
Quicksilver, New York; July, $90.333, August, $85.355

Monthly Copper Production

The crude-copper content of blister copper of the principal producers, in pounds, for April-July, 1920, follows:

MONTHLY CRUDE COPPER PRODUCTION, 1920

	April	May	June	July
Alaska shipments	6,507,515	7,331,590	7,213,820	5,797,645
Arizona:				
Arizona Copper	3,000,000	3,000,000	3,000,000	3,000,000
Calumet & Arizona	3,176,000	4,760,000	4,764,000	4,232,000
Cons. Ariz. Smelting	1,200,000	1,250,000	940,000	750,000
Inspiration	6,000,000	7,500,000	7,300,000	6,500,000
Magma	895,082	918,321	755,601	865,774
Miami	4,924,420	5,054,760	4,400,000	4,549,298
New Cornelia	3,560,000	3,720,000	3,664,000	3,522,000
Old Dominion	2,180,000	2,287,400	2,999,000	2,640,000
Phelps Dodge	5,700,000	6,761,000	6,125,000	5,955,000
Shattuck Arizona	214,122	219,118	198,327	166,938
Ray	4,500,000	4,260,000	4,520,000	4,500,000
United Verde	5,300,000	5,400,000	5,880,000	5,085,140
United Verde Extension	3,270,718	3,219,934	2,828,020	3,304,878
Michigan:				
Calumet & Hecla	9,532,476	8,803,811	9,022,879	8,312,025
Other Lake Superior	6,420,000	6,200,000	6,200,000	6,200,000
Montana:				
Anaconda	15,800,000	9,700,000	12,700,000	11,700,000
East Butte	1,291,840	1,412,760	1,396,140	1,537,880
Nevada:				
Nevada Cons.	4,140,000	4,350,000	4,650,000	4,650,000
New Mexico:				
Chino	3,543,471	3,930,728	4,010,069	4,360,932
Utah:				
Utah Copper	9,313,227	9,904,781	10,000,000	8,500,000
Eastern Smelters	1,610,000	1,600,000	1,600,000	1,600,000
Total reported	102,078,871	101,584,207	104,166,856	97,729,510
Others, estimated	14,000,000	13,380,000	12,000,000	12,000,000
Total United States	116,078,871	114,964,207	116,107,856	109,729,510
Imports: Ore and concentrates, etc	7,766,457	1,607,003	35,911,009	.....
Imports in blister, etc	14,182,933	43,253,540	15,619,398	.....
Grand total	138,028,261	168,824,750	167,638,263	.....
British Columbia:				
Granby Cons.	2,105,400	2,131,219	2,079,000	2,400,000
Mexico:				
Boleo	1,063,168	650,908	802,474	781,613
Cananea	4,000,000	4,300,000	3,750,000	3,500,000
Phelps Dodge Mexican properties	2,098,000	1,141,000	1,427,000	2,402,000
Other foreign:				
Cerro de Pasco	3,942,000	3,890,000	3,944,000	3,652,000
Chile	8,172,000	10,300 000	7,500,000	.....
Katanga	2,601.428	3,847,027	4,323,221	.....
Backus & Johnston	1,354,000	1,726,000	1,382,000	1,458,000

Domestic copper production for 1918, 1919, and part of 1920 follows:

	1918	1919	1920
January	165,431,568	135,733,511	121,903,744
February	160,011,364	111,649,512	117,450,000
March	185,525,168	102,040,460	120,309,316
April	163,207,096	98,808,998	116,078,871
May	181,070,350	92,652,975	114,964,207
June	166,723,599	95,856,570	116,107,856
July	159,329,031	100,369,247	109,729,510
August	165,550,799	107,994,040	.....
September	157,992,487	108,703,075	.....
October	168,638,775	115,143,143	.....
November	159,217,588	117,289,735	.....
December	161,801,916	102,997,633	.....

MINING STOCKS

Week Ended August 28, 1920

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Adventure	Boston	...	...	*50		
Ahmeek	Boston	57⅛	57	57⅛	June '20, Q	.50
Alaska-B.C.	N. Y. Curb	1 1/16	⅞	1 1/16		
Allouez	Boston	23	23	23	Mar. '19,	1.00
Anaconda	N. Y.	53⅛	51⅛	53	Aug. '20, Q	1.00
Ariz. Com'l	Boston	10	9⅛	9⅛	Oct. '18,	.50
Big Ledge	N. Y. Curb	⅛	1/16	⅛		
Bingham Mines	Boston	8⅛	8⅛	8⅛	Sept. '19, Q	.25
Calumet & Ariz.	Boston	55½	54	55½	June '20, Q	1.00
Calumet & Hecla	Boston	295	290	290	June '20, Q	5.00
Canada Copper	N. Y. Curb	1/16	1/16	1/16		
Centennial	Boston	9⅛	9⅛	9⅛	Dec. '18, SA	1.00
Cerro de Pasco	N. Y.	39⅛	37⅛	39	June '20, Q	1.00
Chief Consol.	Boston Curb	...	...	3	Feb. '20, Q	.10
Chile Copper	N. Y.	14⅛	14	14⅛		
Chino	N. Y.	29⅛	26⅛	28¼	June '20, Q	.37½
Columbus Rexall	Salt Lake	*40	*38½	*39½		
Con. Ariz.	N. Y. Curb	1/16	⅛	1/16	Dec. '18, Q	.05
Con. Copper M.	N. Y. Curb	...	...	2⅛		
Copper Range	Boston	34⅛	33¼	34⅛	June '20, Q	.50
Crystal Copper	Boston Curb	*41	*35	*40		
Davis-Daly	Boston	7⅞	7⅛	7⅛	Mar. '20, Q	.25
East Butte	Boston	10⅛	10	10⅛	Dec. '19, A	.50
First Nat'l	Boston Curb	*80	*70	*75	Feb. '19, SA	.15
Franklin	Boston	2⅜	2⅛	2⅛		
Gadsden Copper	N. Y. Curb	...	...	*71		
Granby Consol.	N. Y.	36⅛	34⅛	35⅜	May '19, Q	1.25
Greene-Cananea	N. Y.	25⅛	24⅛	25¼	Aug. '20, Q	.50
Hancock	Boston	3⅛	3	3⅛		
Houghton	Boston Curb	...	...	*40		
Howe Sound	N. Y. Curb	...	...	3⅛	July '20, Q	.05
Inspiration Con.	N. Y.	46⅛	44⅛	46	July '20, Q	1.00
Iron Cap	Boston Curb	...	...	8½	Feb. '19, M	.25
Isle Royale	Boston	27⅛	26⅛	26⅛	Sept. '19, SA	.50
Kennecott	N. Y.	24⅞	23⅛	24	June '20, Q	.50
Keweenaw	Boston	...	...	1⅛		
Lake Copper	Boston	3⅛	2⅛	2⅛		
La Salle	Boston	2⅛	2⅛	2⅛		
Magma Chief	N. Y. Curb	...	...	*21		
Magma Copper	N. Y. Curb	...	...	25⅛	Jan. '19, Q	.50
Majestic	Boston Curb	*11	*11	*11		
Mason Valley	N. Y. Curb	...	...	2⅛		
Mass. Con.	Boston	3	3	3	Nov. '17, Q	1.00
Mayflower-O.C.	Boston	6	5	5⅛		
Miami	N. Y.	19⅞	19⅛	19⅛	Aug. '20, Q	.50
Michigan	Boston	...	...	3½		
Mohawk	Boston	59	58	59	Aug. '20, Q	1.50
Mother Lode (new)	N. Y. Curb	5⅜	5⅛	5⅛		
Nevada Con.	N. Y.	11	10⅜	10⅞	June '20, Q	.25
New Arcadian	Boston	2⅛	2⅛	2⅛		
New Baltic	Boston Curb	...	...	3		
New Cornelia	Boston	17	16⅛	17	Aug. '20,	.25
Nixon Nev.	N. Y. Curb	...	...	*9		
North Butte	Boston	17⅛	14	16⅛	Oct. '18, Q	.25
North Lake	Boston	...	...	⅛		
Ohio Copper	N. Y. Curb	...	...	1/16		
Ojibway	Boston	...	...	1⅛		
Old Dominion	Boston	22	21⅛	22	Dec. '18, Q	1.00
Osceola	Boston	37⅛	36⅛	37⅛	June '20, Q	.50
Phelps Dodge	Open Mar.	†195	†180	...	July '20, Q	2.50
Quincy	Boston	44⅛	43⅛	44⅛	Mar. '20, Q	1.00
Ray Con.	N. Y.	15⅛	14⅛	15⅛	June '20, Q	.25
Ray Hercules	Boston Curb	...	...	*60		
St. Mary's M. L.	Boston	36	36	36	June '20, K	2.00
Seneca	Boston	15⅜	13⅛	15⅛		
Shannon	Boston	1⅜	1⅛	1⅛	Nov. '17, Q	.25
Shattuck Ariz.	N. Y.	8⅛	8⅛	8⅛	Jan. '20, ?	.25
South Lake	Boston	...	...	2		
South Utah	Boston	...	...	*15		
Superior	Boston	4	4	4	Apr. '17,	1.00
Superior & Boston	Boston	3⅛	2⅛	3⅛		
Tenn. C. & C.	N. Y.	9⅛	9⅛	9⅛	May '18, I	1.00
Tuolumne	Boston	*59	*59	*59	May '13,	.10
United Verde Ex.	Boston Curb	31	30	30⅛	Aug. '20, Q	.50
Utah Con.	Boston	7	7	7	Sept. '18,	.25
Utah Copper	N. Y.	62⅛	59⅛	62	June '20, Q	1.50
Utah M. & T.	Boston	1⅛	1	1⅛	Dec. '17,	.30
Victoria	Boston	2	1⅞	1⅞		
Winona	Boston	...	...	*40		
Wolverine	Boston	13⅛	12⅛	13⅛	Jan. '20, Q	.50
LEAD						
Hecla	N. Y. Curb	4 7/16	4⅛	4 7/16	June '20, QX	.20
St. Joseph Lead	N. Y.	16⅞	16⅛	16⅜	June '20, QX	.50
Stewart	Boston Curb	...	...	*16	Dec. '15,	.05
Utah Apex	Boston	1⅜	1⅛	1⅛	Nov. '18,	.25
ZINC						
Am. Z. L. & S.	N. Y.	12⅜	12⅛	12⅛	May '17,	1.00
Am. Z. L. & S. pf.	N. Y.	45	44⅛	44⅛	Aug. '20, Q	1.50
Butte C. & Z.	N. Y.	7⅛	6⅛	6⅛	June 18, I	.50
Butte & Superior	N. Y.	20⅛	18⅛	19⅜	Sept. '17,	1.25
Con. Interst. Cal.	N. Y.	11⅛	10	10	June '20, Q	.50
New Jersey Z.	N. Y. Curb	185	183	184	Aug. '20, Q	4.00
Success	N. Y. Curb	*5	*4	*4	July '16,	.03
Yellow Pine	Los Angeles	‡...	...	1.01	June '20, Q	.03

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	N. Y.	1⅛	1⅛	1⅛		
Alaska Juneau	N. Y.	1⅛	1⅛	1⅛		
Carson Hill	N. Y. Curb	...	...	24⅛		
Cresson Consol. G.	N. Y. Curb	1⅜	1⅛	1⅜	June '20, Q	.10
Dome Ex.	Toronto	*38	*35½	*37		
Dome Mines	N. Y.	11⅛	11⅛	11⅛	July '20, Q	.25
Golden Cycle	Colo. Sprgs.	‡...	...	*73	May '20, Q	.02
Goldfield Con.	N. Y. Curb	*10	*8	*9⅛	Dec. '19,	.05
Hedley	Boston	...	...	4⅛	June '19,	.10
Hollinger Con.	Toronto	5.70	5.60	5.70	Aug. '20, BM	.05
Homestake	N. Y.	...	...	50	Sept. '19,	.50
Kirkland Lake	Toronto	*56½	*54½	*54½		
Lake Shore	Toronto	...	...	1.14	Oct. '19,	.02½
McIntyre-Porcupine	Toronto	2.02	1.99	1.99	May '20, K	.05
Porcupine Crown	Toronto	*26½	*25	*26½	July '17,	.03
Portland	Colo. Sprgs.	‡...	...	*60	July '20, Q	.01½
Reorgan. Booth	N. Y. Curb	5	4	4	May '19,	.05
Silver Pick	N. Y. Curb	*7	*5	*6		
Teck Hughes	Toronto	...	...	*8		
Tom Reed	Los Angeles	‡...	...	1.08	Dec. '19,	.02
United Eastern	N. Y. Curb	2⅛	2⅛	2⅞	Apr. '20, Q	.21
Vindicator Consol	Colo. Sprgs.	‡...	...	*18	Jan. '20, Q	.01
West Dome Consol.	Toronto	*6	*6	*6		
White Caps Min.	N. Y. Curb	*8	*7⅜	*8		
Yukon Gold	Boston Curb	...	...	1⅛	June '18,	.02½
SILVER						
Arizona Silver	Boston Curb	*17	*14	*15	Apr. '20, M	.03
Beaver Con.	Toronto	*4⅛	*43	*43	May '20, K	.03
Coniagas	Toronto	2.55	2.50	2.55	Aug. '20, Q	.12½
Crown Reserve	Toronto	*24⅛	*24⅛	*24⅛	Jan. '17,	.05
Kerr Lake	Boston	...	...	3⅛	Sept. '19,	1.00
La Rose	Toronto	*33⅛	*33⅛	*33⅛	Apr. '18,	.02
McKinley-Dar.	N. Y. Curb	*55	*55	*55	July '20, Q	.03
Mining Corp.	Toronto	...	...	1.75	June '20, Q	.12½
Nipissing	N. Y. Curb	9⅜	8⅞	9⅜	July '20, Q	.25
Ontario Silver	N. Y.	5⅜	5	5	Jan. '19, Q	.50
Ophir Silver	N. Y. Curb	1/16	1/16	1/16	Jan. '12,	.10
Peterson Lake	Toronto	*13⅜	*12⅛	*13½	Jan. '17,	.01½
Temiskaming	Toronto	*35	*32½	*32½	Jan. '20, K	.04
Trethewey	Toronto	*28½	*2 1/2	*2 1/2	Jan. '19,	.05
GOLD AND SILVER						
Atlanta	N. Y. Curb	*2	*1½	*2		
Barnes-King	Butte	‡...	...	1.11	Aug. '20, Q	.05
Bost. & Mont.	Boston	...	...	*63		
Cashboy	N. Y. Curb	*8	*6	*7½		
El Salvador	N. Y. Curb	1⅜	1⅛	1⅛		
Jim Butler	N. Y. Curb	*14	*12	*14	Aug. '18, SA	.07
Jumbo Extension	N. Y. Curb	*5⅛	*4	*5	June '16,	.05
Louisiana Con.	N. Y. Curb	⅛	1/16	1/16		
MacNamara M.	N. Y. Curb	1/16	1/16	⅛	May '10,	.02½
N.Y. Hond. Rosar	Open Mar.	†12½	†10½	...	July '20, QX	.50
Tonopah-Belmont	N. Y. Curb	1⅛	1⅛	1⅛	Jan. '20, Q	.05
Tonopah-Divide	N. Y. Curb	2⅛	1⅞	1⅞		
Tonopah Ex.	N. Y. Curb	2	1⅞	1⅞	July '20, Q	.05
Tonopah Mining	N. Y. Curb	1⅛	1⅛	1 1/16	Oct. '19, SA	.15
West End Con.	N. Y. Curb	1⅛	1⅛	1⅛	Dec. '19 SA	.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*22	*19	*21	July, '20, M	.01
Consol. M. & S.	Toronto	25⅛	25⅛	25⅛	July '20, Q	.62½
Daly Mining	Salt Lake	2.50	2.50	2.50	July '20, Q	.10
Daly-West	Boston	4⅛	4⅛	4⅛	July '20, Q	.25
Eagle & Blue Bell	Boston Curb	...	...	2 1/16	Apr. '20, Q	.10
Electric Point	Spokane	*34	*34	*34	May '20, SA	.03
Fed. M. & S.	N. Y.	10	10	10	Jan. '09,	1.50
Fed. M. & S. pf.	N. Y.	35⅛	33	33	June, '20, Q	1.75
Florence Silver	Spokane	*40	*35	*40	Apr. '19,	01½
Grand Central	Salt Lake	...	...	*37½	June '20, K	03
Iron Blossom	N. Y. Curb	1/16	⅛	1/16	Apr. '20, Q	.02½
Judge M. & S.	Salt Lake	3.97½	3.90	3.97½	July '20, Q	.12½
Marsh Mines	N. Y. Curb	*19	*14	*18		
Prince Consol.	N. Y. Curb	⅛	⅛	⅛	Nov. '17,	.02½
Rambler-Cariboo	Spokane	*14	*12	*14	Feb. '19,	.01
Rex Con.	N. Y. Curb	*6	*6	*6		
South Hecla	Salt Lake	*94	*93	*93	Sept. '19, K	0.15
Stand. S. L.	N. Y. Curb	⅛	1/16	⅛	Oct. '17,	.05
Tamarack-Custer	Spokane	2.25	2.00	2.25	Dec. '19, K	.03
Tintic Standard	Salt Lake	3.40	3.37½	3.40	June '20, Q	0.10
Wilbert	N. Y. Curb	*4⅛	*3	*4	Nov. '17,	.01
NICKEL-COPPER						
Internat'l Nickel	N. Y.	20⅛	19⅜	20	Mar. '19,	.50
Internat'l Nick.pf.	N. Y.	...	...	80⅛	Aug. '20, Q	1.50
QUICKSILVER						
New Idria	Boston	....	....	5	Jan. '19,	25
TUNGSTEN						
Mojave Tungsten	Boston Curb	...	...	*13		
VANADIUM						
Vanadium Corp.	N. Y.	73⅜	68	70	July '20, Q	1.50
ASBESTOS						
Asbestos Corp.	Montreal	80	86½	80	July '20, Q	1.50
Asbestos Corp. pf.	Montreal	93	97	93	July '20, Q	1.75
MINING, SMELTING AND REFINING						
Am. S. & R.	N. Y.	56	54	55⅛	June '20, Q	1.00
Am. S. & R.pf.	N. Y.	90⅛	90⅛	90⅛	June '20, Q	1.75
Am. Sm. pf.A	N. Y.	70⅛	70⅛	70⅛	July '20, Q	1.50
U. S. Sm. R. & M.	N. Y.	53⅛	52	53⅛	July '20, Q	1.50
U.S.S.R.& M. pf.	Boston	44	42⅛	43⅛	July '20, Q	.87½

*Cents per share. †Bid or asked. ‡Quotations missing. Q, Quarterly.
SA, Semi-annually. BM, bimonthly. K, Irregular. I, Initial. X, includes extra